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JULY AND AUGUST ISSUES

BECAUSE of labor difficulties in the plant that prints our magazine we were unable to produce our July and August issues. These omissions marked the first break in regular monthly publication since the magazine was founded in 1896. To catch up with our schedule, this issue is designated as July-August-September. Expiration dates of paid subscriptions will be extended two months to compensate for the issues missed.

ON THE COVER

TO GUARD against car axles failing in service, American railroads prescribe rigid periodical inspection for the detection of flaws. This involves cleaning the axles, a preliminary operation that has heretofore been time-consuming and expensive. Our cover picture shows a machine, recently installed in the Cleveland shops of the New York Central Lines, that cleans an axle in 2½ minutes. The operator is shown turning a hand wheel that moves the brushes laterally. All the other work is performed by air power. A detailed description of the machine appears on Page 186.

IN THIS ISSUE

THE explanation for the fact that dogs sometimes howl or bark without apparent reason is that they hear sounds that are inaudible to the human ear. These high-frequency or ultrasonic sound waves not only can be made to perform parlor magic but they also have numerous known practical uses, with many more probably in the offing. Our leading article outlines the current state of the new science of ultrasonics.

CANADA is fortunate in having abundant sources of water power within easy reach of its largest cities, Montreal and Ottawa, and their contiguous important industrial areas. The Ottawa River system alone has a potential generating capacity of more than 2½ million horsepower, and several hydroelectric stations on this stream are now being added to those in existence. One immediate effect of these new plants will be to end power shortages that have impeded mining operations in several Ontario and Quebec districts during the dry seasons of the past several years. The first of four articles on these developments begins on Page 178.

SEAWEED is a source of several valuable commercial substances and its harvesting and treatment continues to be an important industry in the British Isles despite recent inroads made through the synthetic production of the materials obtained from it. Page 184.

MANY dollars worth of compressed air escapes through openings that are too small to be noticed. Any plant that uses considerable air would do well to check its entire distribution system occasionally to find out how leakproof it is. A method by which this can be done and which was employed by one industrial concern is described on Page 189.

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Magical Waves of Silent Sound

Ultrasonics, a New Branch of Science, Faces a Promising Industrial Future



LOOKING THROUGH A CRANKSHAFT

Representatives of the New York City firm of Sam Tours & Company, Inc., use ultrasonic vibrations generated by a Sperry Reflectoscope to search for defects in the crankshaft of a diesel engine. The vibrations pass through sound parts of the metal, but if they strike a flaw or other imperfection they bounce back to the transmitter and

are indicated on the screen of a cathode-ray tube. The relative positions of these indications on the screen serve to distinguish between defects and intentional features such as oil holes, stud holes, etc., as well as to locate the defects in relation to the surface. With equipment of this kind one can spot imperfections in castings 30 feet thick.

NEWEST, most dramatic, and possibly the most important branch of science now being developed for general industrial use is ultrasonics, which is an integral part of the general science of acoustics.

The term ultrasonics generally is taken to mean sound waves that are pitched too high for the human ear to hear. Sound itself is nothing but a series of energy waves or vibrations that causes pressure pulsations in the medium in which it is traveling. The intensity of a particular sound—its pressure variation—is measured in decibels, zero decibels being the lowest audible level. The frequency or pitch of the sound, which is determined by the number of times the pressure increases or decreases in a unit of time, is expressed in cycles per second.

Most persons can hear sounds having frequencies lying between 500 and 18,000 cycles per second, while those having frequencies of 20,000 cycles per second and up are ultrasonic.

These high-pitched energy vibrations may be generated with many different types of equipment (at present compressed-air generators appear to be the most practical) for a number of unprecedented tasks such as the dispersion of immiscible liquids, the agglomeration of industrial-smoke particles, the location of flaws in materials that cannot be detected with X-rays, the destruction of bacteria, the stimulation of plant growth, and the production of unusual heating effects—all of which will be discussed presently.

Many ultrasonic phenomena have

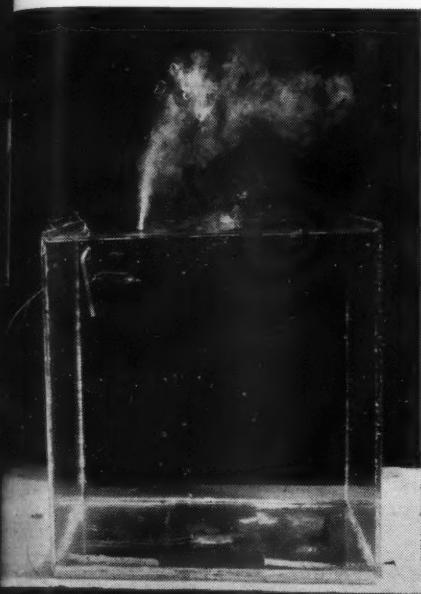
been known to scientists for more than a century; but, like electrostatics, the subject as a whole was for many years considered "theoretically beautiful and thoroughly impractical." At least one of the first investigations in this field was conducted by C. Despretz, a French physicist, in 1845. However, it is generally agreed that the subject branch of acoustical science lacked even a firm theoretical foundation prior to research work by Germany's Hermann Helmholtz and England's Lord Raleigh over a period of about 40 years in the latter part of the nineteenth century. As a matter of fact, no noteworthy uses for ultrasonic phenomena are known to have been suggested prior to World War I.

During the latter conflict, P. Langevin, another French physicist, endeav-



ULTRASONIC FOUNTAIN

Sound waves pitched too high for human beings to hear cause water to spurt from a tank, left, in laboratory experiments. Voltage applied across the terminals of a dime-sized disk of barium titanate suspended in the tank vibrates the disk at frequencies approaching 3,000,000 cycles a second. The concave surface of the disk focuses the waves upward, causing a jet of water to spring from the surface of the liquid along the path of the waves' emergence. The picture below shows ultrasonic waves breaking water into tiny droplets and dispersing it as fog. The apparatus was built by engineers of the General Electric Company to demonstrate and to study some of the curious properties of ultrasonics.



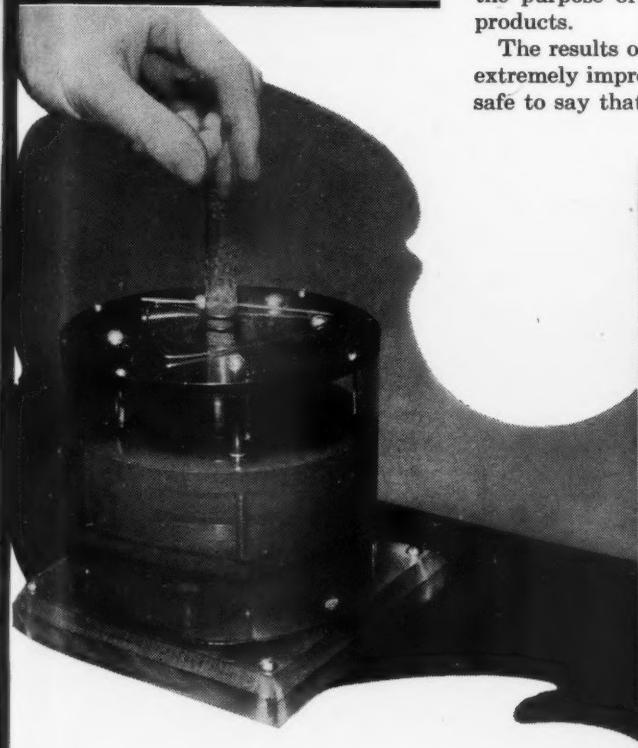
orded to develop ultrasonic equipment suitable for locating submerged German U-boats; but even that idea remained impractical until the first "Sonar" and "Radar" units were produced for World War II. Particular attention was focused on ultrasonics during that conflict by the striking success of the many devices that were developed to locate submarines, icebergs, sunken vessels, etc. Sonar waves, for instance, sent out through the water by a vibrating metal diaphragm attached to a ship's hull, could reach underwater craft miles distant. Reflected back to the ship, they were picked up by a receiver and converted into an electrical impulse that flashed a light on a dial to show how far away the submarine was. Therefore, when the war ended, men were tempted for the first time to explore the possibilities of ultrasonics for the purpose of creating new industrial products.

The results of these efforts have been extremely impressive, although it is still safe to say that not more than the sur-

face of ultrasonic potentialities has been penetrated. Research has, in many respects, been limited to ultrasonic waves of lower frequencies and higher intensities, or higher frequencies and lower intensities, owing to a lack of satisfactory generators. As has already been said, many different types have been designed and tested; but, on the whole, they share one or more disadvantages such as high cost, inadaptability, and operational inefficiency—at least, in their present state of development.

For instance, crystal-type generators have been rather prominent in laboratory work because they are comparatively adaptable and useful when both high and low ultrasonic frequencies are required. However, in view of the fact that the operation of each necessitates the production of vibrations in a piezoelectric crystal (the crystal is energized by the terminals of a radio-frequency amplifier), output is normally of low intensity while cost is relatively high and efficiency leaves much to be desired. This is especially true where higher frequencies are needed, because much energy is lost in the majority of cases by submerging the crystal in a cooling oil bath to prevent heat damage.

Magnetostriction generators, wherein electromagnets are energized by an oscillating current so as to vibrate ferromagnetic materials by causing rapid dimensional variations, have been inex-

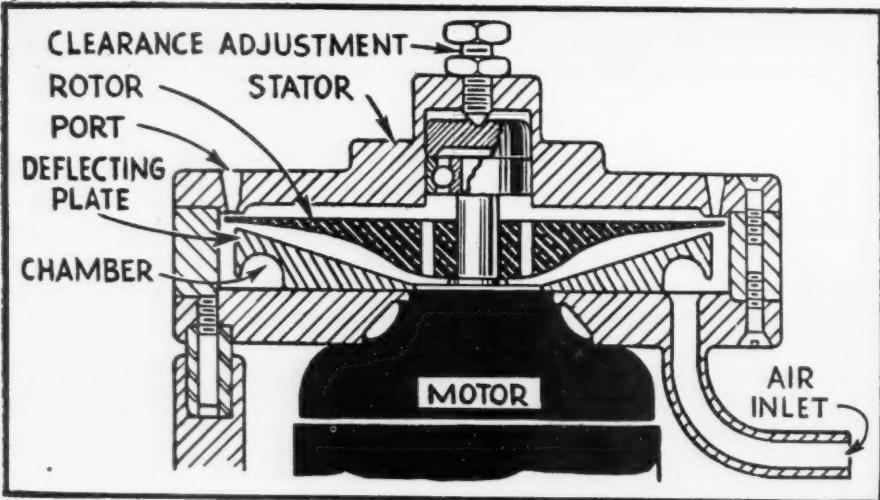


PHOTOS, GENERAL ELECTRIC COMPANY

FEATS OF SILENT SOUND

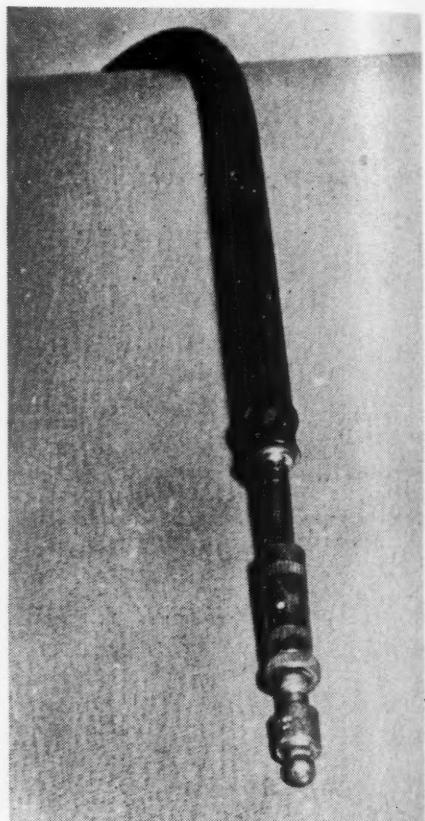
Ultrasonic sound waves can do many seemingly impossible things. For instance, most persons believe that oil and water will not mix. But high-pitched sound waves passed through a test tube containing oil and water (above) create a mixture of minute droplets that will not separate for years. In the view at the right, bits of cork floating in midair are apparently defying gravity. They are supported by ultrasonic waves generated by a compressed-air whistle and reflected downward by a sheet-metal focusing hood. The little pieces are floating half a wave length apart above the point of high intensity.





AIR-OPERATED GENERATORS

One of the simplest ways of creating ultrasonic waves is to use compressed air. The diagram shows a side view of an air-operated siren developed by Pennsylvania State College to aid in research work. As the air escapes from the chamber of the siren through ports it is chopped into a series of pulses by the whirling teeth of the rotor, each pulse becoming an ultrasonic sound wave. Pictured below is an ultrasonic whistle attached to a compressed-air line.



pensively purchased as war-surplus Sonar equipment and used to produce ultrasonic waves of considerable intensity. But aside from the fact that these units probably cost more than crystal generators when they are new, they are subject to large heat-energy losses and more or less confined to a frequency output of less than 100 kilocycles.

Tuning forks are suitable for classroom demonstrations of ultrasonic phenomena, but individually they are incapable of developing more than a single frequency and must be energized by a generator of another type. Ultrasonic frequencies of 30 to 300 kilocycles have been experimentally produced by friction and electrical spark-gap equipment, but at this writing units in these categories appear to be nothing more than laboratory curiosities.

Most practical investigators are apparently of the opinion that the answer to the problem of ultrasonic generation will be found in compressed-air equipment, and in this connection encouraging results have been obtained, as previously suggested, although considerable work remains to be done. For instance, General Electric Company is one of the few firms that are known to have inaugurated a program for the development of a compressed-air whistle suitable for the purpose of generating ultrasonic frequencies and intensities. The whistle is probably the simplest and least-expensive form of generator that can be devised, and has been used in ultrasonic test work since 1883 when the initial "Galton pipe" was produced. However, it seems that most research engineers are inclined to believe that units of this type are limited to low frequencies and intensities. Reporting on the subject in 1949, General Electric's L. G. Osterman said in part:

"The whistle can be adjusted for frequency by varying the depth of the cylinder. This can be done by turning the piston adjustment screw. The whistle can be operated at any frequency above five kilocycles, which includes the ultra-

sonic range starting at 20 kilocycles.

"For best operation and maximum power output in the audible frequency range, the distance between the cylinder and the tube should be adjusted to give the loudest sound. At inaudible frequencies, sound can be felt as a pressure on the fingers and this pressure should be at a maximum value for optimum performance of the whistle. General Electric engineers have operated this generator at air pressures from 20 to 70 pounds per square inch with excellent results."

At this writing, sirens are apparently becoming the most prominent of all the ultrasonic generators. They can be operated with compressed air to produce acoustical waves as intense as 200 decibels and at virtually all frequencies including subaudio vibrations having frequencies of less than 10 cycles per second useful principally in laboratory work; audiosonic or audible vibrations having frequencies from about 10 to 20,000 cycles per second (at high intensities they can, in some respects, be used like waves of higher frequencies); and ultrasonic vibrations having frequencies of 20,000 or more cycles per second. These can be efficiently generated with less intensity and less power than audiosonic vibrations and for a comparatively great variety of purposes.

Operationally, the object of any siren is to eject a flow of air through a sequence of apertures so that it will be broken up into pulsations of a certain frequency and intensity. In the ordinary one-note unit, such as the audiosonic type that serves firemen, a manually controlled blower may be used simultaneously to create a flow of air and, by teeth or projections on its rotor, to break it up for passage through a perforated disk or plate. But in the case of the average ultrasonic siren it is desirable to produce waves of varying frequencies and intensities. This is done by keeping its housing under pressure and by either contrarotating two perforated disks or rotating a rotor adjacent to a stator, both perforated, by separate mechanical

means so that the compressed air will escape from the siren as ultraintense or ultrahigh-frequency waves of predetermined quality or quantity.

Several English and Australian firms are reportedly making ultrasonic sirens of various types for different purposes, and a number of educational institutions such as the University of California at Los Angeles has used custom-built units for experimental work over a period of years. But so far as is known, only two American organizations—Ultrasonic Corporation of Cambridge, Mass., and G-B Brass & Aluminum Foundry, Inc., of Los Angeles—have developed ultrasonic sirens for commercial installation. The former was the first to start actual production, and the resultant equipment has been officially described by Harold W. Danser and Ernest P. Neumann, as follows:

"These generators consist of a rotor, facing a stator, with precision-matched ports around the periphery of each. A compressed gas is passed through the ports of the rotor and then of the stator.

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As the rotor turns, alternately opening and closing the ports of the stator, the gas flows out intermittently through the stator ports. An intense sound wave is thereby created at the interface, and is directed by an acoustic horn from the generator. Intensity of the sound wave is governed by the pressure of the compressed gas and frequency by the speed at which the rotor turns. To govern the rotor speed, a variable speed motor may be used in conjunction with an auto-transformer. About 225 cfm. of gas, compressed to 8 psi., gauge, are required to operate this generator; this gas flow may be obtained from a compressor requiring about a 10-hp. drive motor."

Incidentally, no special compressors have had to be provided for Ultrasonic Corporation sirens in plants that were already equipped with such units. For example, in Aluminum Company of America's factory at Vernon, Calif., a sufficient pressure for the operation of a siren of this kind was obtained without interfering with other pneumatic work

by using a double regulator to reduce some of the 100-pound output pressure of a centralized Ingersoll-Rand compressor to a siren-input value averaging 10 psi.

Structurally, the G-B Brass & Aluminum Foundry siren is similar to Ultrasonic's generator except that the latter is designed for high-sonic intensities while the former seems to be more suitable for high-sonic frequencies. Dr. E. A. Alexander of the California Institute of Technology was responsible for the development of the G-B siren of which the components, excepting the steel drive shaft, are sand-cast of high-tensile manganese bronze. Included are a housing, a mounting ring, a stator, and a rotor, the last two being 16-inch disks perforated, respectively, with 120 holes each $\frac{3}{16}$ inch in diameter. The rotor is mounted on the drive shaft so that it can be rotated by a 3 1/2-hp. motor at speeds up to 12,000 rpm.

The completely assembled generator has an over-all length of 18 inches, a

maximum outside diameter of 17 inches, and weighs 240 pounds. The purpose of the initial unit was to agglomerate factory-smoke particles in conformity with local smog-control regulations. It was successfully operated at frequencies averaging 20 to 22 kilocycles with a 310-cfm. I-R compressor, which was regulated for an output of 50 cfm. in order to maintain an internal siren pressure of only 5 pounds.

Considerable attention has been focused on the G-B siren, for, as Alcoa works engineer A. E. Huotari has pointed out, high-intensity generators are rather expensive for smoke-agglomeration purposes in large industrial plants. However, this does not mean that the Ultrasonic Corporation siren has failed to find important applications in such establishments. According to Dr. Clyde Berg of Union Oil Company's refinery at Wilmington, Calif., one of the latter type has served with success in connection with a new shale-oil retorting process.

"In the retorting of shales," Doctor Berg reports, "an appreciable portion of the oil produced leaves the unit as a mist in the gases drawn from the base of the unit. The character and extent of this mist also varies with the grade of shale being retorted. Fifty- to fifty-five gallon shales produce an effluent gas mixture containing a relatively small quantity of mist of large particle diameter which is readily agglomerated by the conventional blower equipment and is easily collected. Thirty- and seventy-gallon shales exhibit more appreciable mist formation in their retorting operation, and particles are of a relatively small diameter. This mist requires special handling; however, it is completely recovered in the combination Ultrasonic agglomeration and Roto-Clone collection equipment of the shale unit."

Considerable output intensity is apparently a necessity in virtually all industrial agglomeration generators because it would otherwise be difficult to propagate ultrasonic waves through large areas in a gaseous medium. However, frequencies appear to be dependent, in many respects, on the size or mass of the particles which must be agglomerated. For example, where the particles involved were of large dimensions (up to 10 microns) audiosonic frequencies as low as one kilocycle sufficed, whereas smaller ones have usually required higher frequencies.

In any event, many engineers maintain that the greatest advantages of ultrasonics will be realized through the use of vibrations of high frequencies (up to about 500,000 kilocycles) and low intensities (less than 100 decibels) because then it will be possible to concentrate the tremendous heat energy of ultrasonic vibrations (at frequencies of 300 or more kilocycles) without endangering operating personnel and without huge power



PHOTO, GENERAL ELECTRIC COMPANY

CRYSTAL GENERATOR

Shown here is an experimental unit that generates high-frequency sound waves from a quartz crystal. The latter is about the size of a hockey puck and is contained in a plastic case mounted on top of the unit's cabinet. When voltage is applied across the terminals of the crystal it vibrates, sending out sound waves. The glass chimney catches the spray of fluids that are placed in the center of the case and "boiled" by the ultrasonic sound waves.

losses, as well as to propagate ultrasonic vibrations in various solid or liquid mediums in accordance with the resonance values of the materials.

The high-frequency heat energy of ultrasonic waves was recently indicated by Norman Barnes of the General Electric Company in the statement that a kilowatt of ultrasonic power may be concentrated within an area a centimeter square, which is about ten times the energy concentration of a white-hot tungsten-lamp filament. Accordingly, it is rather difficult to discredit recent reports to the effect that British manufacturers have used ultrasonic-siren equipment to provide the heat that is required to weld and solder metals, including some of the new "superalloy" steels.

The usefulness of ultrasonic energy in connection with solid substances is well exemplified by resonance testing. This consists, briefly, in generating an ultra-

sonic "beam" at a frequency which depends upon the resonance of a solid so that the beam can be "bounced" through the material much the same as a ray of light penetrates and is reflected by a mirror. This technique is very helpful because it is possible thereby to compute the time it takes an ultrasonic impulse to bounce through a solid and thus indicate the presence or absence of flaws in the material. Further, the reflected impulse can be picked up for amplification like a radio signal to actuate a cathode tube. The latter resembles the picture-tube of a television set, except that its face is calibrated to permit the visual interpretation of the reflected signals, which vary with the nature of the internal structure that has delayed or accelerated their transmission.

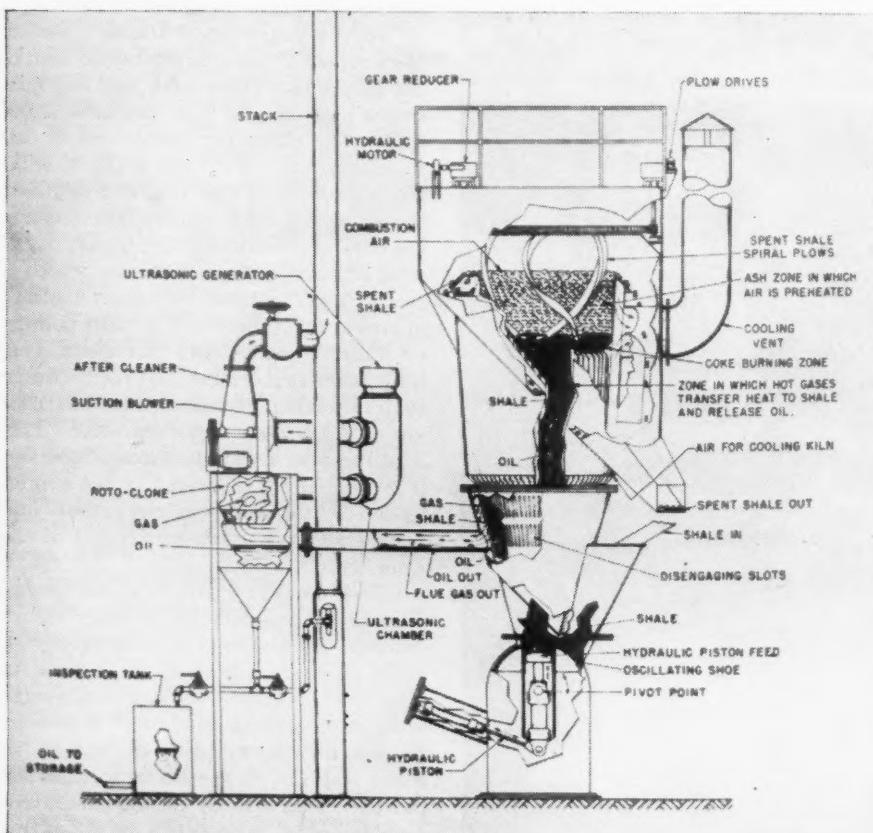
Sperry Products, Inc., is believed to be the pioneer producer of ultrasonic "reflectoscopes"—resonance-testing equip-

ment that has been used by companies such as Todd Shipyards at San Pedro, Calif., for the purpose of locating defects in alloy castings which were as much as 30 feet thick and which X-rays could not penetrate.

General Sound Company of Burbank, Calif., has developed an ultrasonic washing machine for commercial laundry work. It makes use of an ultrasonic generator or "transducer" to disperse vibrations with a resonance value suitable for sudsy water, and is said to do a much better job than conventional paddle machines in a fraction of the time and at a comparatively low cost. Recent news reports from Australia claim that an ultrasonic washer for home use has been invented there, but General Sound's chief engineer Jack Hibbard doubts that such a machine is practicable.

According to Frank Massa, director of Massa Laboratories, Cleveland, Ohio, the efficiency of washers of this type can be attributed to the power of ultrasonic vibrations to increase the wetting action of a liquid cleaning solution. And in this connection it is interesting to note that Massa has developed ultrasonic equipment for degreasing or cleaning industrial materials or products with standard chemical solutions. All this is of considerable importance because it reduces the cleaning time by a margin of at least 90 per cent.

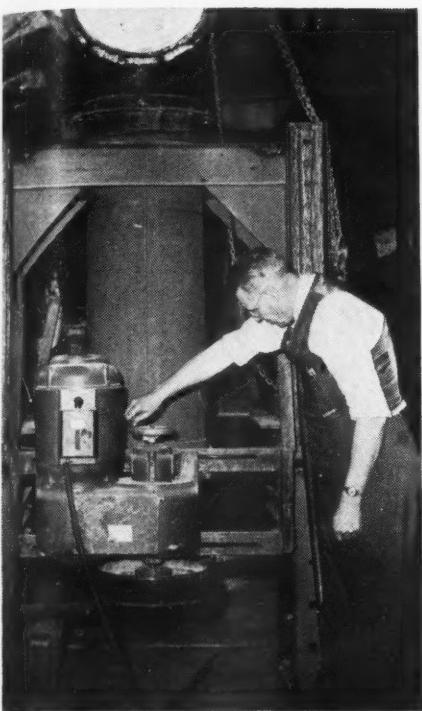
Dr. Isadore Rudnick, physicist for the University of California, has utilized a pint-sized ultrasonic siren to kill small insects and rodents with varying degrees of success, depending upon the resonance or acoustical conductivity of the respective creatures. In consequence, he believes that exterminators of the future will substitute apparatus of this kind for poisons and traps.



CATCHING OIL-SHALE MIST

An oil-shale retorting plant developed and operated by The Union Oil Company at Wilmington, Calif. (right) uses an ultrasonic siren to reclaim oil escaping as a fine mist from the retorting chamber. The siren, manufactured by Ultrasonic Corporation, agglomerates the fine particles and makes it possible to recover them. The diagram shows construction and operational details of the plant.





INDUSTRIAL-MODEL SIREN

A. L. Goodreau, president of G-B Brass & Aluminum Foundry, Inc., demonstrates the controls that regulate the output of the air-operated ultrasonic siren developed for his company by Dr. E. A. Alexander of the California Institute of Technology. It has so far found use mainly in agglomerating fine particles of smoke, soot, dust, etc., but holds considerable promise in other fields.

Ultrasonic sirens have also served at the Navy Landing Aids Experimental Station near Arcata, Calif., to precipitate fog so that aircraft could land, but there is some room for doubt as to whether they will find wide application in this service because of the possibility of undesirable physiological reaction among bystanders. However, the Navy has made effective use of ultrasonic generators (designed by Bell & Howell Company of Hollywood) at the Naval Air Station near Los Alamitos, Calif., in producing "beams" which have enabled pilots to bring their flying machines down with safety regardless of obscuring smog or fog.

Further, investigators for the U. S. Department of Agriculture at Beltsville, Md., have reportedly done satisfactory work with ultrasonic vibrations in stimulating the development or germination of various seeds and tubers. And doctors at Princeton University's medical school are said to have experimented with ultrasonic equipment in an effort to find a remedy for internal diseases such as cancer which would normally require surgery.

Engineers at Woodwelding, Inc., Burbank, Calif., are currently looking into the potentiality of ultrasonic generators in connection with the dielectric molding or curing of plywood laminae. They

are of the opinion that high-frequency vibrations will maintain the molecular alignment of wood veneers and plastic adhesives so that the latter can be heat-set without the difficulties incident to "steaming."

For the textile industry, Brush Development Company, Cleveland, Ohio, has produced ultrasonic equipment that can be used to accelerate chemical reactions (sometimes eliminating the need for conventional catalysts) to emulsify or disperse immiscible fluids such as water and oil and to speed up general operations like sizing and dying. Similarly, the new Industrial Products Division of Pillsbury Mills, Inc., Minneapolis, Minn., is reportedly mixing or processing food and related products with the aid of units of this type.

Battelle Memorial Institute of Columbus, Ohio, is said to have developed ultrasonic tools with which unprecedented tasks such as grinding and drilling ceramics can be readily accomplished. Among them are ultrasonic disintegrators with which the toughest materials can be broken down into particles that will pass through a 200-mesh screen in a few minutes.

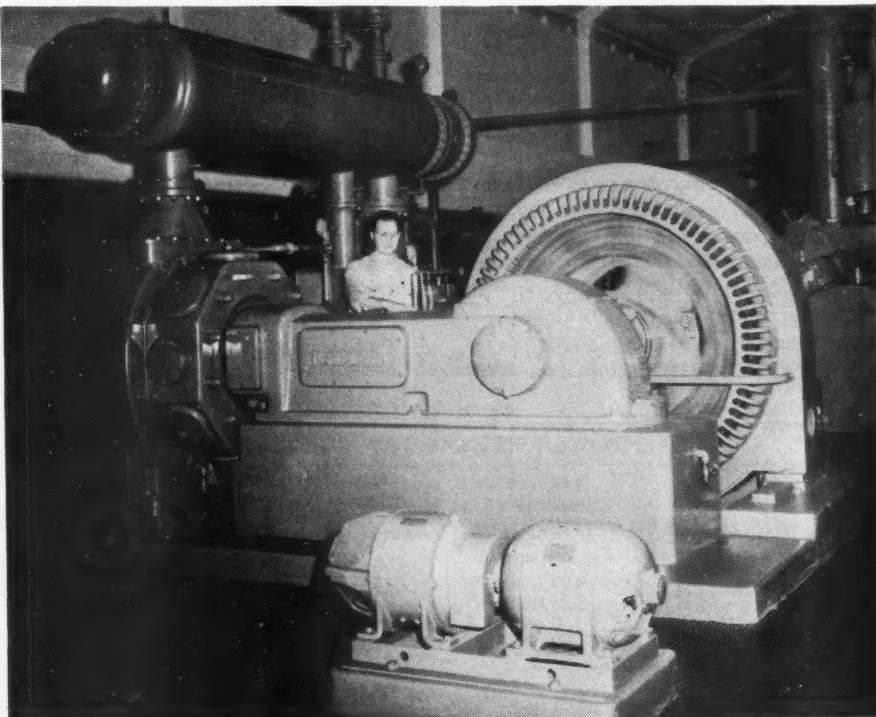
At plants of the National Lead and American Steel & Wire companies, engineers have made use of ultrasonic vibrations to alloy metals such as copper and iron (this could not be done previously because their different melting points

caused them to separate while cooling) and also to increase the homogeneity of cast alloys by providing the agitational energy necessary for the efficient "degassing" of molten metals. Chemists for Sherwin-Williams Paint Company are known to have resorted to ultrasonic generators in mixing new-type coating materials, while Seagram Distilleries likewise have availed themselves of the unique properties of "silent" sound waves in accelerating the chemical reactions involved in the making of aged liquors.

Other ultrasonic applications, which currently remain in the experimental stage, include the vaporization of liquids, the dispersion of metals in electrolytic operations, the drying of paper sheets in pulp mills, the homogenization of milk, and the making of stable photographic solutions. Many additional ones will no doubt be conceived and developed at an increasing rate, for there seems to be no doubt that most of the problems connected with the generation and use of ultrasonic vibrations are being solved.

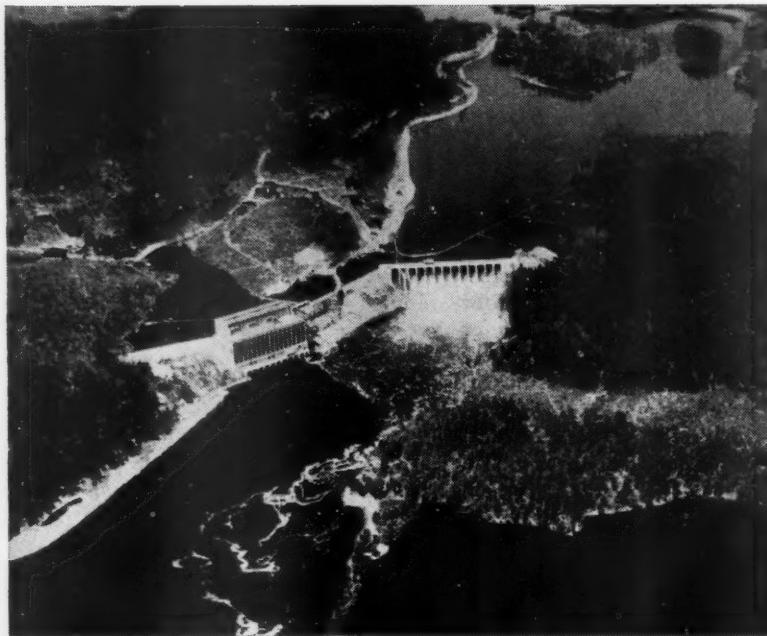
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Ultrasonics, by Benson Carlin, published by McGraw-Hill, New York, 1949.



POWER FOR ULTRASONIC GENERATORS

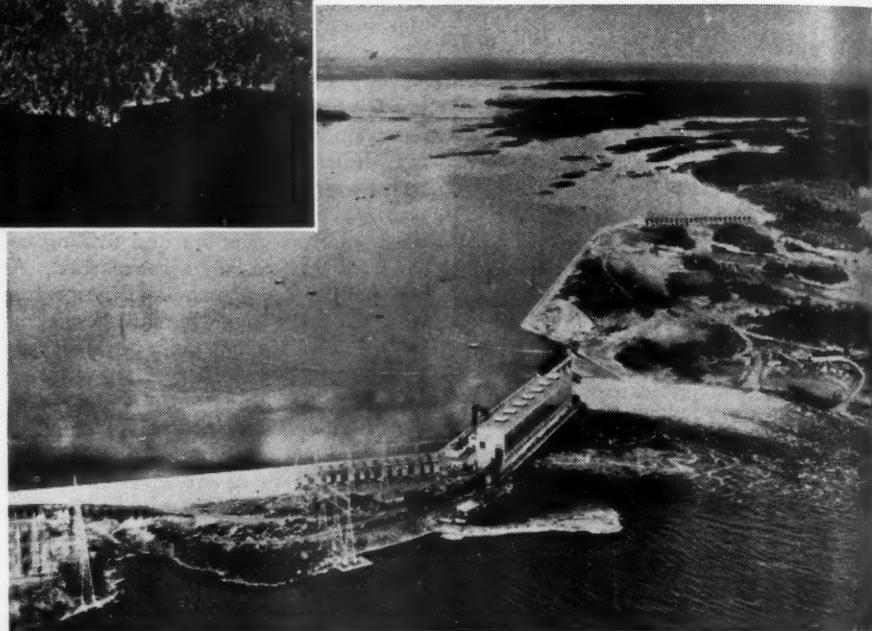
The incorporation of air-operated ultrasonic apparatus in manufacturing processes does not involve the installation of additional sources of power if suitable centralized plant equipment is available. Units like this Ingersoll-Rand air compressor in the plant of C. F. Braun & Company, of Alhambra, Calif., have in several different factories eliminated the need of providing individual compressors for ultrasonic sirens.



Ottawa River Power Development

Low-Cost Electricity is Gradually Transforming the Economy of Central Canada

W. M. Goodwin



CENTRAL CANADA, devoid of coal, is fortunate in having an abundance of water power that can be harnessed at comparatively low cost. Partial use of the available energy has permitted the provinces of Ontario and Quebec to emerge during the past 50 years from a rather primitive economy, based mainly upon farming and lumbering, into a balanced economy in which natural resources contribute to substantial and varied manufacturing industries. Without low-cost hydroelectric power few of the industries would have been able to compete with products from outside sources, and the inhabitants would have remained purveyors of raw materials.

Among the rivers that are furnishing this wealth of power, the Ottawa holds a strategic position and is one of the more completely developed of the group. It taps a watershed of 60,000 square miles, the southern part of which adjoins old settled sections of the two provinces. The main stream has a total length of 700 miles. In the upper stretch, just south

GENERATING PLANTS ON MAIN STREAM

The 81,000-hp. Bryson Station of the Gatineau Power Company at the left is located 66 miles upstream from the City of Ottawa. Approximately 30 miles below it is the Chats Falls plant shown above. The latter is owned jointly by the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Company, Quebec. It has a capacity of 224,000 hp.

of the great gold-copper-zinc belt containing the Val d'Or, Noranda-Rouyn, and Kirkland Lake mines, the direction of flow is westward. Turning south through Lake Timiskaming it reaches Mattawa and the famous old canoe route

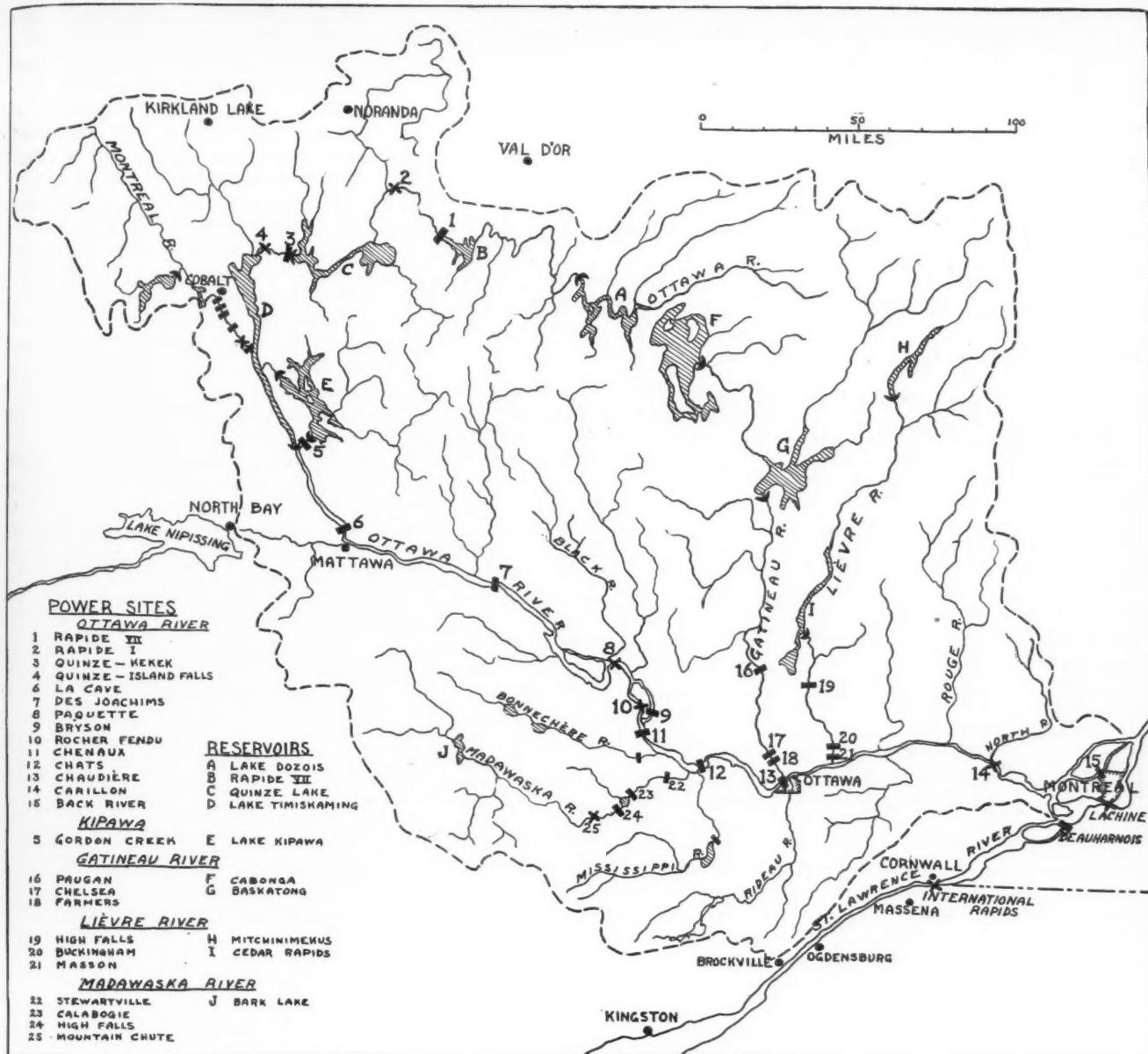
originally used by the Indians and later by the early explorers and voyageurs in their travels toward the center of the continent. From Mattawa downstream to its junction with the St. Lawrence at Montreal, a distance of 300 miles, the river courses eastward, first through 100 miles of hills and woods and then through forests on the left and flat, fertile land on the right.

In the northeast corner of the watershed, where the famous old Cobalt silver camp is situated, is the southern lobe of the Great Clay Belt. In this area, a glacial lake of 40,000 years ago deposited clay or, rather, rock flour which now covers the surface so deeply that only the higher hills rise above it like islands in a plain. This district supports agricultural activities that are of some importance to the region's gold and copper camps.

Only about one-tenth of the Ottawa watershed is arable land. The remainder is a hilly area of lakes, rivers, and forests, the central part reaching an elevation of

POWER SITES, OTTAWA RIVER

SITE	INSTALLED HORSEPOWER	UNDEVELOPED HORSEPOWER	HEAD FEET
Back River	45,000	—	22
Carillon	—	500,000	60
Chaudiere	109,000	50,000	40
Chats Falls	224,000	—	53
Chenaux	160,000	—	40
Bryson	81,000	—	
Rocher Fendu	—	200,000	65
Paquette	—	70,000	15
Des Joachims	480,000	—	130
La Cave	204,000	—	70
Quinze - Kekok	85,000	35,000	110
Quinze - Island Falls and Devil Chute	—	150,000	150
Rapide I	—	120,000	70
Rapide VII	64,000	55,000	70
	1,452,000	1,180,000	895



OTTAWA RIVER SYSTEM

The main river is about 700 miles long. With its tributaries it drains 60,000 square miles of territory on which the annual precipitation ranges from 30 to 40 inches. The gradient of the stream system provides numerous sites for power development, and topographic conditions afford abundant opportunities for the creation of storage reservoirs to insure an even flow and, consequently, more or less continuous operation of turbines. Already, the river has been harnessed sufficiently to prevent floods in the lower reaches. When the plants under construction are completed, the installed generating capacity will

be 1,452,000 hp. The potential capacity at undeveloped sites so far investigated is 1,180,000 hp., or a total of 2,632,000 hp., with some additional sites probably still available. The power is fed into a grid system that covers virtually all the industrial area radiating from Montreal and Toronto. The locations of the stations now in operation or under construction are identified by means of bars, and the undeveloped sites by crosses. The half-moon symbols indicate dams which have been erected to create impounding reservoirs for the purpose of stabilizing the downstream flow.

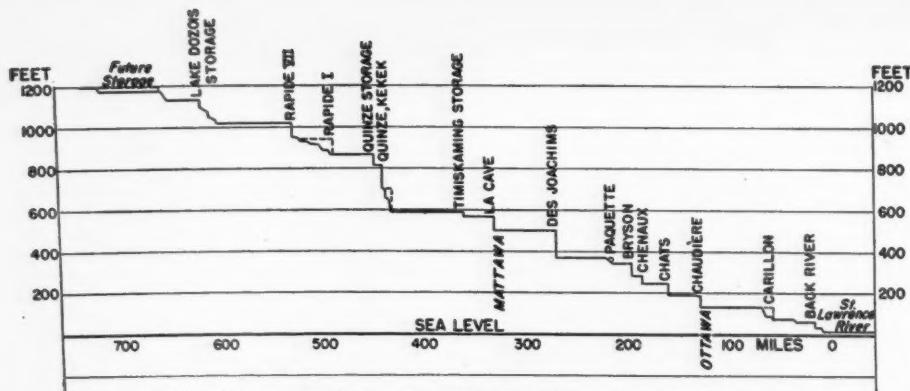
2000 feet. The lakes are rock-rimmed and provide natural reservoirs, some being of considerable extent. The topographical conditions also are the cause of abrupt changes in the streams, marked by falls and rapids where rocky banks usually offer fine locations for power plants. This combination of natural storage and power sites is an ideal one and gives the hydraulic engineer an excellent opportunity to practice his profession.

Lumbering in the primitive forests was the chief occupation in the Ottawa

watershed for a century. With the tall timbers gone, pulpwood cutting became predominant. The region now maintains half a dozen large paper mills and can do so in perpetuity, provided a systematic forestry policy is adopted. One hundred miles of railway and a good road system make its southeastern section, the Laurentians, readily accessible to the million and a quarter people of Montreal. Starting within view of the city, this area, with its lakes and hills, is a vast winter and summer playground, somewhat like the Adirondacks in the United States.

With an annual precipitation of 30 to 40 inches, the Ottawa drainage basin is well watered. Swamps, lakes, and the forest floor provide good natural storage, and numerous sites have been found where inexpensive dams can impound large volumes of water from the spring runoff. This artificial storage is already materially increasing the natural minimum flow, particularly on tributaries such as the Gatineau, Lièvre, and Madawaska.

The total drop from the forebay of the uppermost developed site, Rapide VII,



PROFILE OF OTTAWA RIVER

The total drop from the forebay of the uppermost developed power site, Rapide VII, to the tailrace of the lowest, Back River on Montreal Island, is 986 feet. Of this head, 895 feet can be utilized by continuing the construction program until stations are operating at all the points indicated.

to the tailrace of the lowest one—Back River—on Montreal Island is 986 feet. Of this, 895 feet, or more than 90 percent, can be harnessed by using the head at fourteen points. At Rocher Fendu and Bryson the river is divided by an island with a power site on each side, so the accompanying profile shows only thirteen. Including plants now under construction, the installed capacity at nine is 1,452,000 hp. Undeveloped sites have a potential of 1,180,000 hp., making a total of 2,632,000 hp.

As indicated on the plan and profile, most of the power sites have substantial impounding reservoirs above them. The dam to be built at Carillon, for instance, will back up the water to Ottawa, a distance of 70 miles averaging well over a mile in width. The Des Joachims Dam has formed a lake equally wide and 50 miles long. The Chenaux Dam, on the other hand, has only 8 miles of the widened river behind it. The large amount of water immediately available in most of these nearby storages permits great flexibility of plant operation. For example, full operation of the Chats Falls station for about ten hours a day lowers the forebay from 9 to 10 inches. During the night only one or two of the eight units are kept running and the forebay level rises again to its regulated maximum.

Control of the Ottawa's annual flow is still far from complete, although three large reservoirs on the main river are now in use, as well as others on tributaries. These have already increased the minimum flow at the upper sites to an appreciable extent, while their effect on the lower ones—those below the large regulated tributaries—is still more pronounced.

From his home at Ste. Anne de Bellevue, at the west end of Montreal Island, the writer has for years observed the results of this control. Two decades ago, at the Rapids of Ste. Anne's, the water came down in the spring with a mighty

roar and the river was impassable to navigation. Now, high flood is a thing of the past, and the crests of the rolling waters are barely broken by the spring flows.

Two additional areas suitable for large storage basins have been located near the headwaters of the Ottawa, and others will doubtless be found when needed. They will, of course, still further regulate the flow and permit the production of more power at all the downstream sites. No accurate estimate has yet been made

of the ultimate hydroelectric capacity of the river.

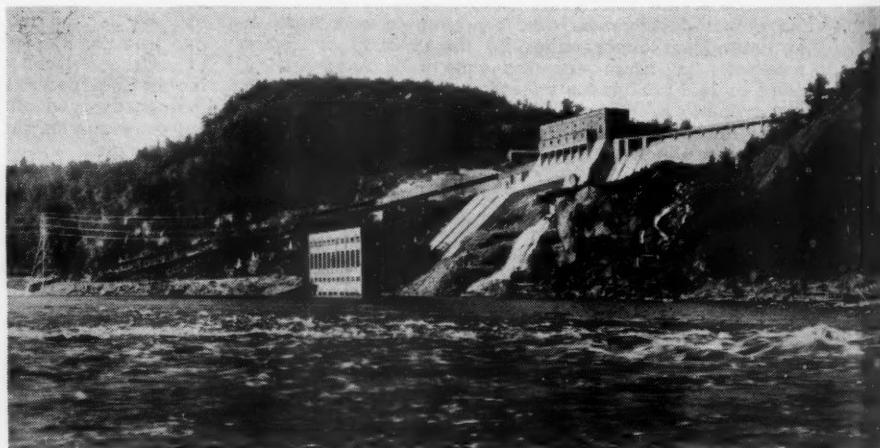
From the head of Lake Timiskaming to within 40 miles of Montreal, the Ottawa constitutes the boundary between Quebec and Ontario. The sites from La Cave downstream to Carillon have therefore been divided between the two provinces in such a way as to be equitable and most convenient for both. In general, those nearer Toronto have been allotted to Ontario, and the ones closer to Montreal are held by Quebec. There is an equal division at Chats Falls where a powerhouse was built before the general agreement was made. Another exception is Chaudiere, at Ottawa, which was developed many years ago by six companies with as many small stations.

The Hydro-Electric Power Commission of Ontario is virtually a monopoly, for

PRINCIPAL RESERVOIRS

	STORAGE CAPACITY ACRE-FEET
Main River	826,000
Lake Timiskaming	992,000
Quinze Lake	401,000
Rapide VII	1,680,000
Lake Dozois	1,050,000
Gatineau River	2,160,000
Cabonga	425,000
Baskatong	425,000
Lievre River	300,000
Cedar Rapids	562,000
Madawaska River	73,000
Mitchinimekus	
Kipawa (Gordon Creek)	
Bark Lake	
Montreal River	
Lake Kipawa	
Lady Evelyn Lake	

it owns and operates nearly all the larger water-power plants in the province. Many small ones still belong to municipalities and private interests, but their total output is inappreciable. Second to the Niagara River, the Ottawa is at present Ontario Hydro's largest source of electric energy. Its importance to the province is accentuated by the fact that most of the power generated in Quebec's half of the Chats Falls plant, at Bryson, and on the Gatineau and Lièvre rivers is bought by Ontario Hydro and the bulk



HIGH FALLS STATION

This 120,000-hp. plant is one of the three on the Lièvre River that are owned by the MacLaren-Quebec Power Company. It operates under a head of 180 feet. The current produced there is used chiefly in a large pulp and paper mill located at Masson, Que.

of it is transmitted at 200,000 volts 200 miles westward to Toronto and vicinity. Only a small percentage is required to serve the paper mills, factories, municipalities, and farms of the Ottawa Valley.

Quebec has only recently adopted the idea of public ownership of power, and a large part of the business is still in private hands. In the Ottawa watershed, the uppermost plant at Rapide VII was developed under provincial ownership and is now operated by Quebec Hydro to serve the Noranda mining area. Quebec's half of the Chats Falls powerhouse, and the Bryson, Chaudière, Gatineau, and Lièvre stations are all owned by private companies. It seems likely, however, that the large Carillon and Rocher Fendu projects will be undertaken by public authority. But work on them will probably not be started for some time to come because Quebec has about two million undeveloped horsepower at Lachine and Beauharnois on the outskirts of Montreal.

As has already been mentioned, most of the electricity now generated on the Ottawa, Lièvre, Gatineau, and Madawaska rivers is transmitted 200 miles to Ontario's center of industry around the western end of Lake Ontario. While most of the current is consumed in this

TRIBUTARIES OF OTTAWA RIVER			
	DEVELOPED SITES	DEVELOPED HORSEPOWER	UNDEVELOPED HORSEPOWER
Gatineau	3	528,000	—
Lievre	3	273,000	—
Madawaska	3	147,000	40,000
Montreal	5	31,000	30,000
Kipawa	1	24,000	—
North	3	10,600	—
Rouge	2	8,800	—
Rideau	2	4,400	—
Mississippi	3	6,800	—
Bonnechere	2	2,300	—
Black	2	6,600	—
Mattawa	1	1,100	—
		1,343,600	70,000

area, actually one great system of lines covers the whole southern part of the province from the Quebec border 500 miles west to Windsor. An interconnection is to be made in the near future with the extensive network that supplies the great mining region of the North. It is into this vast common pool that the power from the Ottawa watershed will be fed.

All Ontario's remaining sites on the Ottawa are at present under development. Des Joachims is expected to have four of its eight 60,000-hp. units in operation during 1950, and the remainder

early in 1951. Chenaux is to be put in service during 1951 and La Cave in 1952. Thus, before the end of 1952, Ontario Hydro should place 844,000 hp. of new power from the Ottawa River at the disposal of its customers. These undertakings, by the way, cover only about half the Commission's present construction program, which includes two auxiliary steam plants.

The fact that the three large Ottawa sites just referred to are being developed simultaneously, in addition to those on other rivers farther west, calls for an explanation. During World War II, power facilities were taxed to the utmost, but work on new projects was necessarily postponed because all the authorities fully expected that cessation of hostilities would be accompanied by a decided let-down of industry that would restore Ontario's prewar comfortable surplus of hydroelectric energy. In place of the slump came a boom, and the demand for power was soon considerably in excess of the wartime peak. The result has been a 3-year shortage that is soon to be relieved by the completion, among others, of the Chenaux, Des Joachims, and La Cave projects. Descriptions of their engineering features will be given in succeeding articles.



GATINEAU RIVER DEVELOPMENTS

Seven miles above the junction of the Gatineau and Ottawa rivers are the Chelsea and Farmers plants of the Gatineau Power Company pictured at the right. Their combined capacity is 290,000 hp. The Farmers Station is in the foreground. The other view shows the same company's 238,000-hp. plant at Paugan Falls 23 miles farther upstream.



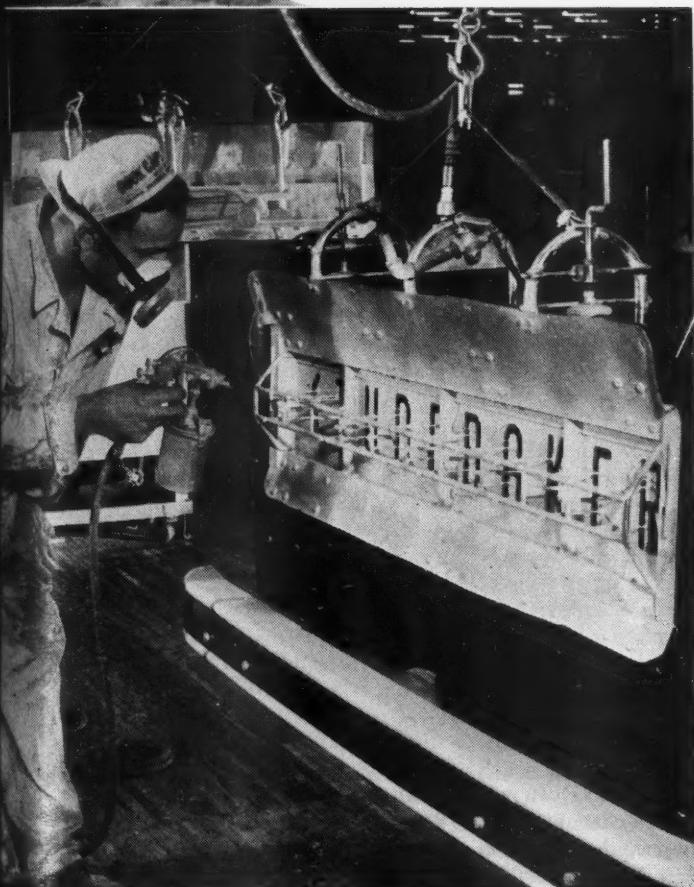
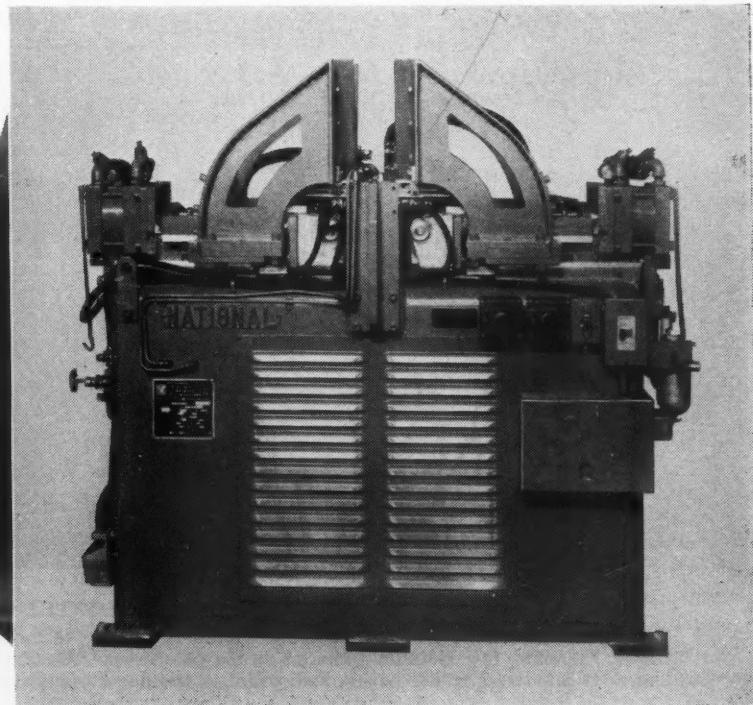
COMPRESSED AIR AT WORK



In the Harley-Davidson Motor Company plant at Milwaukee, Wis., motorcycle connecting-rod bearings are checked instantly and accurately to within one ten-thousandth inch with the Sheffield Precisionaire flow-type air gauge shown mounted at the left of the honing machine in the picture above. Seven other Sheffield air gauges are used for checking thirteen dimensions of essential parts. By eliminating error and reducing spoilage, these measuring devices improve the quality of the final product and cut manufacturing costs.



Cars that are dumped by the action of air cylinders have long been used, especially in the mining and construction fields. Now the German firm of Orenstein & Koppel has introduced a full-size boxcar (left) that embodies an additional feature. As it is being tilted, one side member is automatically raised to facilitate discharging. The car was designed as a grain carrier and has a capacity of approximately 118 cubic yards. By merely connecting an air hose and turning a valve its load can be dumped in a few seconds.



In the manufacture of stainless-steel knives and forks, hot upsetting of the rods from which they are formed is essential so as to redistribute the metal and obtain the desired thicknesses at certain points prior to forging. To perform the work of upsetting, National Electric Welding Machines Company, of Bay City, Mich., has designed the machine shown above. In it, each rod is heated electrically, then upset near both ends by the action of opposing air-operated cylinders. The operator only keeps the supply hopper loaded with rods; the machine feeds, upsets, and ejects them automatically. It processes 800 rods an hour, thus providing sufficient forging stock to make 1600 knives or forks. The first two machines are now in service in one of the nation's leading cutlery plants.

The tail gate of each Studebaker truck bears the company name in embossed white-enamel letters, $4\frac{3}{8}$ inches high, that are sprayed on through a metal stencil. Air-operated clamping fixtures enable one operator to apply the coating fast enough to keep pace with the assembly-line movement of 25 vehicles an hour. In the first of the two pictures at the left he is shown turning a valve that admits air under 45-50 psi. pressure to two $1\frac{1}{4}$ -inch cylinders which hold the stencil firmly in place on the opposite side of the tail gate. A quick-acting connector simplifies hooking up the air line, and a spring balancer suspended from an overhead monorail relieves the operator of muscular effort in handling the heavy mask assembly. In the near picture he is doing the spraying. After being used five or six times, the stencil is cleaned by soaking it in a tank of denatured ethyl acetate for a few minutes, scrubbing it with a fiber brush, and drying it under a suction hood. With three assemblies on hand, one is in use while the second is soaking and the third is drying.



PHOTOS FROM ALGINATE INDUSTRIES LIMITED

HAY FROM THE SEA

A seaweed processing plant in the Outer Hebrides, Scotland. There the raw material gathered on the gale-swept shores is dried and milled before being sent to mainland

factories for further treatment. The actual method of extracting the useful chemical constituents is a trade secret, but various substances are obtained.

Seaweed — the New Provider

Marine Growth Is the Basis of an Extensive United Kingdom Industry

Arthur Nettleton

FABRICS, pharmaceutical preparations, paints, rubber substitutes, polishes, paper, ice cream and food-stuffs are just a few of the things now being made from or with the aid of seaweed which litters the coast of the United Kingdom. To fully appreciate the importance of this development it should be realized that only fifteen years ago most of that country's seashore wealth was going to waste. Some varieties were regarded as edible in certain localities, and others were being harvested for their iodine; but beyond that the humble marine plants were looked upon as valueless.

Science and the war have changed all that, and a big future is forecast for one product from Britain's brown seaweed alone. The latter yields alginic acid or agar-agar, a substance that already has a long list of applications. Our grandparents knew it as isinglass and used it as a preservative and for cooking. Before the conflict, the demand for it was on the increase because test chemists

found that it served them well when they needed a jelly capable of remaining solid under all conditions.

But prior to 1939, the only big supplier was Japan. She did a world-wide trade in alginic acid obtained from Ceylon moss harvested in her waters, selling at the rate of more than nine million pounds a year to some European countries and exporting equally big weights to the United States and Canada. When the war lords of Nippon sided with the Nazis and deprived Britain of agar-agar, the blow was a serious one. That's why the government immediately appointed experts to investigate her own seaweeds. Vast beds were located by aerial photography, and specimens were collected for laboratory tests at Edinburgh and elsewhere. At a research station on the Isle of Man other experiments were made to determine, among other things, just how fast each of the different species grows. Even records of old customs were consulted. It was learned, for instance, that Scottish Lowlanders chewed a seaweed called

dulse long before chewing tobacco was known. So quantities of it were gathered and tested to ascertain just what properties made the stuff chewable.

The Ministry of Supply eventually set up a Scottish Seaweed Research Association to probe still further into the mysteries of marine vegetation and to put it to use. The discoveries made have been astonishing. More than a score of industries have found applications for them, and some new ones have been established as a result of the experiments. At Leeds University, for example, a seaweed extract has enabled its textile department to weave wool into fabrics of a far finer texture than was hitherto thought possible. In the past, the limit of fineness for practical purposes was governed by the breakage point of the threads in the looms. Ultrathin yarns were liable to snap in the machines and produce cloth with imperfections. Today the finest threads can be made temporarily strong by giving them an alginic coating. After the material has been

woven, the extract is washed off, leaving a pure-wool fabric of extreme lightness and beauty.

Another novel product from seaweed is soluble yarn which serves a very useful purpose in the hosiery industry. Socks have long been knit in a continuous length and then separated by unpicking them at the joints. By the present method, which is much easier and quicker, a few rows of soluble thread are knitted in at the toes and tops and simply dissolved. Then, too, glamorous stockings and diaphanous lingerie are being fashioned from lustrous rayon filaments spun from a mixture of algin and metal. This material is fireproof and waterproof and offers great possibilities also as a fabric for curtains, for upholstering, etc.

The prospects of the increasing use of alginates in the textile industry are so promising that the British Government is building more factories in Scotland for processing seaweed. South Ulst, one of the Outer Hebrides group of islands, had the first drying and milling plant for tangleweed deposited on beaches by Atlantic storms. Thousands of tons of seaweed have gone from there and northern Ireland, which is another prolific source of the raw material, to mainland factories for the extraction of the valuable alginates.

Seaweed that grows between the low- and high-water marks is easiest to harvest. Gathering starts at high tide, the plants being forked into nets as the water recedes and leaves it on the shore. A single reaper may harvest fifteen hundred-weights in an hour, though the average rate is about ten an hour. The filled nets are then floated to a point for collection and carting to the processing factory. Gathering seaweed that is never un-

covered by the tide presents a bigger problem, but the difficulties are being overcome with the help of the Engineering Division of the Institute of Seaweed Research.

At Oban, Scotland, grappling irons, which tear the plants from the sea bed in 2-yard strips, have been tried out, and now a continuous grapnel attached to a moving belt is undergoing tests. Another idea is a device fitted with rotating knives that can be lowered from a boat. To promote this phase of the work an experimental tank has been built at Inveresk Gate, Musselburgh; and, in conjunction, efforts are being made to ascertain whether seaweed that is readily harvested can be introduced anywhere along the coast of Britain. In the Pacific Ocean there are giant floating varieties that can be gathered easily. So spores have been obtained, and attempts are being made to cultivate them in Scottish waters. If they are successful, seaweed farms may become a reality.

Basically, the methods by which the alginates are extracted from seaweed involve digestion by sodium carbonate or a hydroxide solution, followed by precipitation of the resultant alginic acid by means of a mineral acid. The processes by which these operations are performed, and which are directed mainly towards purifying the product, are secret (most of them are patented). Sometimes bleaching and filtration are resorted to, and the weed may be given a preliminary washing to recover soluble by-products such as iodides. Alcohol is often used to facilitate the removal of water and impurities from the freshly precipitated alginic acid. The latter looks like finely ground oatmeal when dry, but when mixed with water it becomes a pure white jelly with exceptional cell-forming properties.

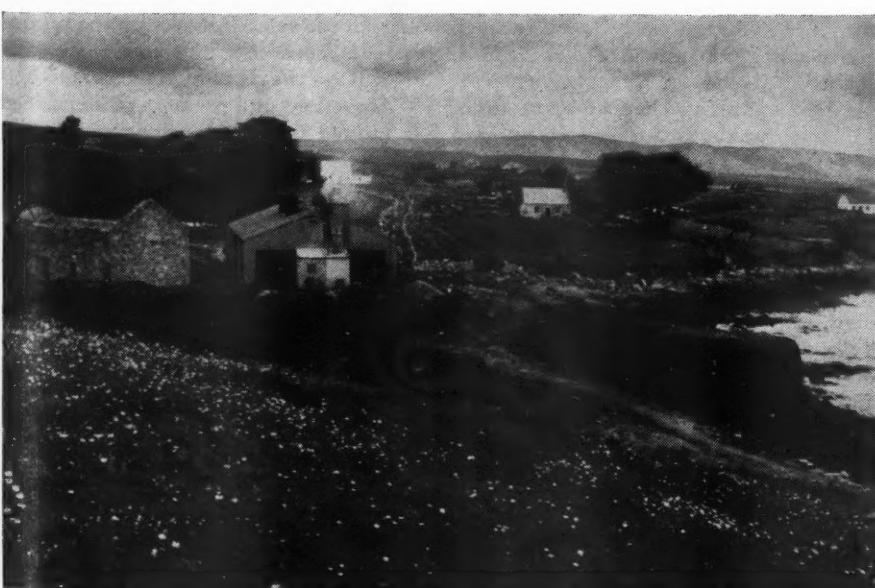
In addition to its applications in the textile field, alginic acid has pharmaceutical value, meeting a need in bacteriological research and serving as a surgical dressing. Hospitals use it widely, and in dried and powdered form it is taken as a protection against goitre. The medical world has recently made a discovery that promises to add still further to the importance of seaweed. It has been found that haemorrhage can be stanched by means of a soluble wool made therefrom. So far the tests have been confined to dental operations, in which the "wool" has proved its worth. Now those responsible for that development are concentrating on ways of applying it so as to make surgery bloodless.

The soap, paint, aniline-dye, and synthetic-rubber industries are hopeful of finding increasing uses for marine vegetation through laboratory work. Alginates have already been vulcanized the same as rubber and converted into typewriter rollers and similar articles. Still another product of seaweed is a transparent and particularly tough kind of paper. It also provides a flavoring for ice cream and a thickener for soups. Oddly enough, the extraction of iodine from kelp, which was one of Britain's earliest commercial uses of seaweed, is no longer important. Most of it is now obtained as a by-product in the purification of Chilean sodium nitrate. However, kelp, one of the coarsest varieties of seaweed, still serves the glass manufacturer.

A new chapter is being added to the romance of seaweed nearly every day. A most promising avenue lies in the recent discovery of a constituent that has been named lamarin. Just what its merits are is still uncertain; but judging by past experience, it will soon be added to the long list of extracts which come from the plants of the sea.

Surveys of the beds around the shores of Britain show that there is never likely to be a shortage of the most useful species. To ascertain just where they grow, a research ship, the *Prospecto*, was fitted out for the purpose with special harvesting gear as well as with a pressing, drying, and milling plant. More than 250 distinct varieties have been identified and carefully classified, and another government chemistry division has investigated their seasonal organic and inorganic constituents.

The Research Association is of the opinion that seaweed can create an industry worth at least \$75,000,000 a year. The present and potential schemes of harnessing Scotland's lochs and fast-moving rivers to supply cheap electric power are expected to encourage the establishment in that part of Britain not only of seaweed processing and extraction plants but also of factories that will need their products. Already, two hosiery firms have built weaving mills there based upon the use of alginates.

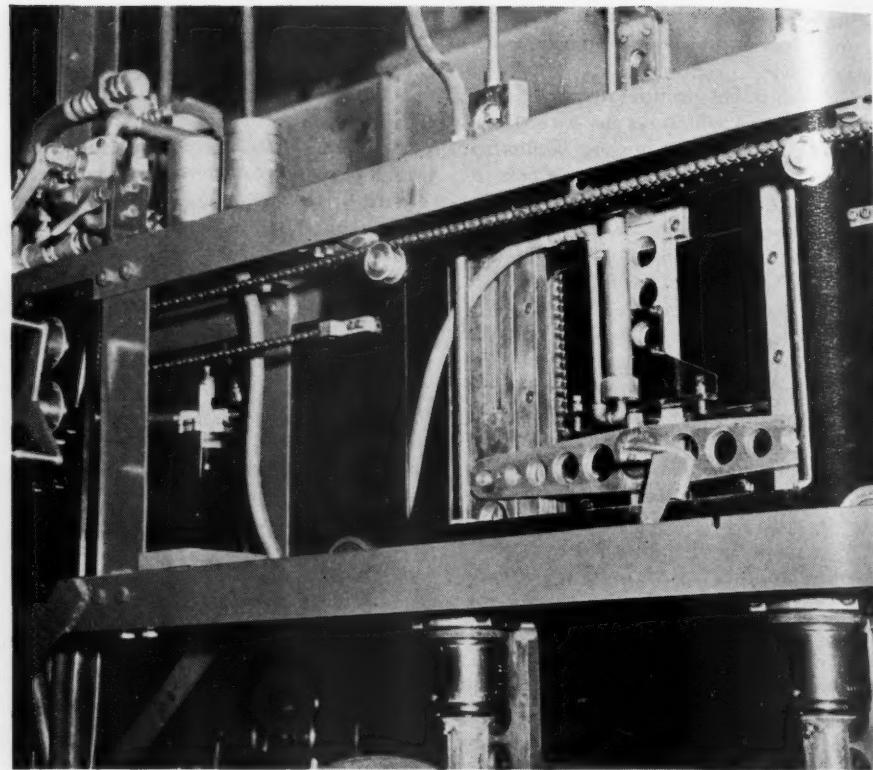
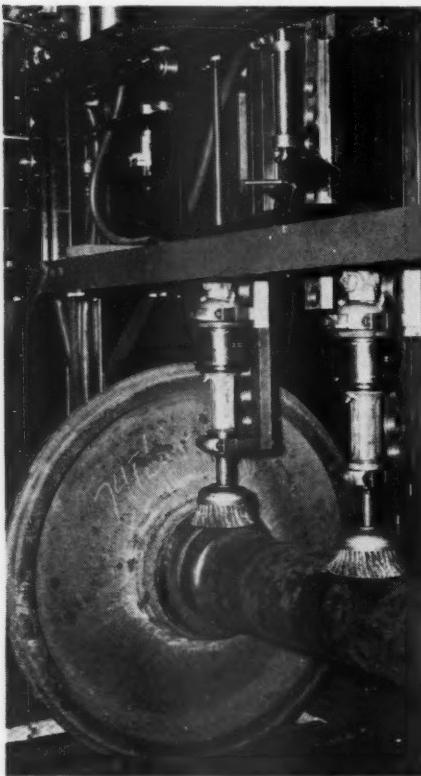


IRISH SEAWEED FACTORY

Western Ireland, like Scotland, is rich in offshore marine plants which are harvested in large quantities for the extraction of their chemical contents.

DETAILS OF MECHANISM

Slide-mounted air motors with the brushes they operate are illustrated below. The other picture shows the traveling carriage with the equalizing arm and air cylinder by means of which the brush slides are raised and lowered. An over-all view of the machine with a car axle in cleaning position appears on the cover.



Cleaning Car Axles Preparatory to Magnafluxing

F. A. Corson*

THE requirements of the Association of American Railroads that all railway-car axles shall be magnafluxed has created the problem of discovering a safe and efficient method of thoroughly cleaning them preparatory to performing that operation. To the uninitiated, magnafluxing is a simplified method of detecting surface cracks, seams, etc., in steel that cannot be discovered by the aid of even a powerful microscope. The part to be inspected for flaws is magnetized and then sprayed or flooded with oil in which finely powdered black magnetic iron is held in suspension. Magnetization sets up a polarity between any cracks or breaks at or close to the surface of the metal and attracts the particles of iron oxide to them. There they adhere, forming a black line that is plainly visible.

In order that the work of cleaning might be done economically, the New York Central Railroad Experimental Department, which is located at the Collinwood Shops in Cleveland, Ohio, has recently designed and built an air-operated machine that is said to have several distinct advantages, namely: low first cost; high volume production at low

labor cost; and minimum operating and maintenance expense. The equipment straddles the incoming tracks but does not interfere with the passage of wheels and axles that are not to be cleaned. And as the operation is completed before the wheels are demounted, no heavy lifting or transfer of wheels and axles is required.

Wheels and axles, as a unit, are simply run on a standard-gauge track through the machine. If the axle is to be cleaned, it is spotted over a pit housing an elevating and rotating mechanism by means of which the axle is turned on its own wheels. The wheels, themselves, are rotated at a speed of 25 rpm. by an Ingersoll-Rand Size 40 Multi-Vane close-quarter drill which is directly mounted on a shaft to which are keyed four heat-treated, serrated steel wheels 8 inches in diameter. The speed can be regulated by a needle valve placed ahead of the drill. The elevating mechanism is raised and lowered by two air cylinders installed in the pit.

Cleaning is done by two Osborne Manufacturing Company wire cup brushes each of which is powered by a Size 4 Multi-Vane air motor and operated at 4500 rpm. The motors are attached to two vertical slides which form part of a traversing carriage that runs in a 12x21x114-inch box section and is moved by a hand wheel. The two bottom angle irons of the box section, which is fastened to

two vertical end supports and spans the pit, serve as a track on which the ball-bearing wheeled carriage rides.

The vertical slides to which the air motors are secured are suspended on a balancing arm which is raised and lowered by a small pneumatic cylinder. This method of suspension permits equalization of the brushes, causing them to conform to the out-of-round and contoured ends of the axle. Pressure on the brushes is controlled by a counter-balancing weight on the back of the carriage.

Air is used at a pressure of 90 psi. and is filtered to remove vapor and foreign matter. It is delivered to an upright pipe, on one side of the frame, which carries it into the pit and to an overhead extension with three hose connections leading to the air motors and cylinder on the traveling carriage. There are three Norgren line oilers, one each for the brush motors and the Multi-Vane drill that turns the car wheels, while six Alemite grease fittings on the elevating mechanism do all the lubricating that has to be done daily.

By means of the machine one man, it is claimed, can thoroughly clean a railway-car axle in 2½ minutes. This speed and economy of operation is largely attributable to the use of standard compressed-air motors and pneumatic cylinders and to the fact that the work of cleaning is done without handling—lifting and lowering—the wheels and axles.

*Supervisor Experimental Department, New York Central Railroad.

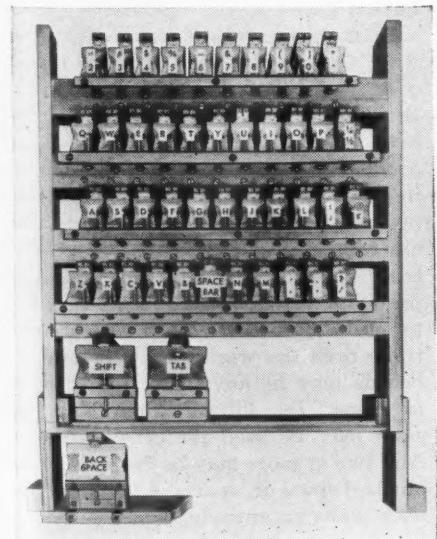
An Air-Operated Automatic Typewriter



AUTO-TYPIST CONSOLE

Any standard typewriter can be converted to automatic operation by mounting it as shown here. The dials at each side are switches for making the change from manual to mechanical operation. Perforated record rolls, one containing various paragraphs and the other names and addresses, are mounted inside the housing. The operator selects the ones desired by punching numbered keys on each side of the machine. Paragraphs may be typed in any sequence, the roll turning at high speed until the one designated is reached. Then it slows to typing speed.

AIR is taking over one of the big time-consuming chores of stenographers and typists, that of writing form letters which differ only in address and salutation. Much of the typed material sent out by offices and agencies is direct-mail advertising and stock replies to routine inquiries. To facilitate clerical work of this kind, the American Automatic Typewriter Company has developed the "50" series air-operated Auto-typist, a machine that will automatically turn out up to 100 average-length paragraphs by means of any standard typewriter.

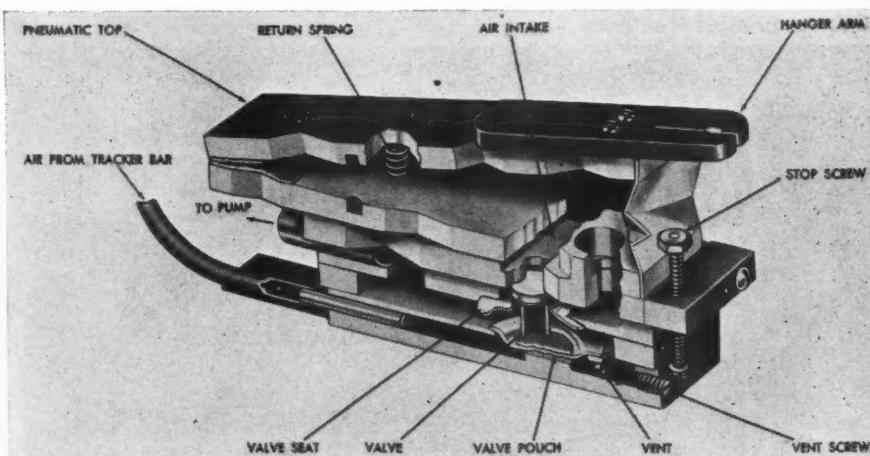


Perforated rolls, similar to the record rolls which operated the old player piano, are fed to the Auto-typist. Two are generally used and are punched on a special machine either in the office or by the manufacturer of the Auto-typist. One

carries names and addresses taken from a mailing list; the other is perforated with a series of holes which represent the letter to be sent to each name on the list. But in the case of mail for which no address roll has been cut, the addresses as well as the date are typed in the regular way and only one roll is used to operate the machine automatically. Many different letters can be written simply by changing the record roll, a one-minute job.

Operation of the machine is based on the vacuum principle. Vacuum is induced by an electrically driven pump consisting of four bellows, each connected to the crankshaft spider by a pump strap. The bellows work in succession and the action is continuous, so that vacuum is maintained all the time the motor is running. A vital part of the mechanism is a tracker bar, a metal strip with a series of holes, one for each typewriter key as well as for the shift, tabulator, stop, skip, repeat, and rewind actions. Rubber tubes connect the tracker-bar openings with the various keys and with "action pneumatics" mounted in banks underneath the typewriter. There is one for each key, to which it is connected by a wire.

When the operator presses a push button to start the Auto-typist, the roll is drawn over the tracker bar. Outside air enters one of the pneumatics through a valve mechanism, equalizing the air pressure exerted on top of the pneumatic while a compression spring keeps the bellows in raised position, as shown in an



HOW KEYS ARE OPERATED

The bank of "action pneumatics" shown at the left is mounted under the typewriter. Each pneumatic—one for each character on the keyboard—is connected to its key by a wire. A cutaway view of an individual pneumatic appears above. The hanger arm is normally in the position shown, being kept raised by the return spring. When the roll perforation corresponding to the key is reached, a valve opens a channel leading to a bellowslike space beneath the hanger bar and the air is exhausted. The bellows then collapses, draws down the hanger arm and thus actuates the key. As the roll moves on, the connection to the vacuum pump is broken, air is admitted to the bellows, and this, plus the spring action, raises the bar and lets the key return to rest. The striking force of the keys is regulated by a governor that controls the degree of suction induced. Typing speed depends upon the rate at which the record rolls turn.

accompanying illustration. As each perforation in the roll passes over the corresponding hole in the bar, an impulse of air from the tracker bar travels down through the tube to the valve and enters the vent channel below the valve pouch. This combination of atmospheric pressure on the underside of the pouch and pump suction on the upper side causes the pouch to lift the valve off its seat and to close the air intake. When in this position, the valve opens a passage from the bellows to the vacuum channel, permitting the pump to withdraw the air from the bellows. The latter then collapses, drawing down with it the hanger arm and wire to which the typewriter key is attached, thus actuating it.

As soon as the opening in the tracker bar is closed by the movement of the roll, the flow of impulse air through the tube ceases, the vacuum pump withdraws what air remains in the tube and vent channel, and the valve pouch and valve return to their normal or "down" position. This closes the passage from the bellows to the vacuum channel and opens the air intake. The flow of outside air into the bellows, plus the action of the spring, raises the bellows and releases the typewriter key. The sequence of operations is almost instantaneous, and the

key is released in time to make room so the next key can come into action.

Any make of typewriter, including noiseless, can be easily mounted on the Auto-typist. In the case of an electric machine, the carriage is returned by a key on the typewriter keyboard that is depressed by a small pneumatic like those that operate the other keys. On all other types it is shifted by a cord fastened to the spacer lever at the side left of the carriage proper. The speed at which the Auto-typist works varies with the typewriter and is set at the time of installation. The touch is adjustable so it will correspond to that of the operator.

Speeds may run as high as 150 words a minute, or sufficient to produce up to 200 letters a day. The machine also addresses envelopes automatically at the rate of nearly 1500 daily and can be used to do billing and invoicing with a typewriter designed for that purpose, the Auto-typist printing the address, terms, and services rendered. It is claimed that the machine, largely because of the flexibility of the pneumatics, permits operating any typewriter at its maximum speed and, what is also important, leaves the typist free for nonrepetitive work while it is in action.



UNOBTRUSIVE STACKS

This municipal power-generating station in Lansing, Mich., has stacks but they are hardly evident. By designing them on the venturi principle, with induced-draft fans in their bases, Prat-Daniel Corporation, of East Port Chester, Conn., kept them so short that they could be concealed in the parapet at the top of the plant. At first glance the structure looks like an office building. This aesthetic touch was imparted to it in deference to the civic pride of the residents of Michigan's capital city.

Lumber Trimmer with Air-Controlled Saws

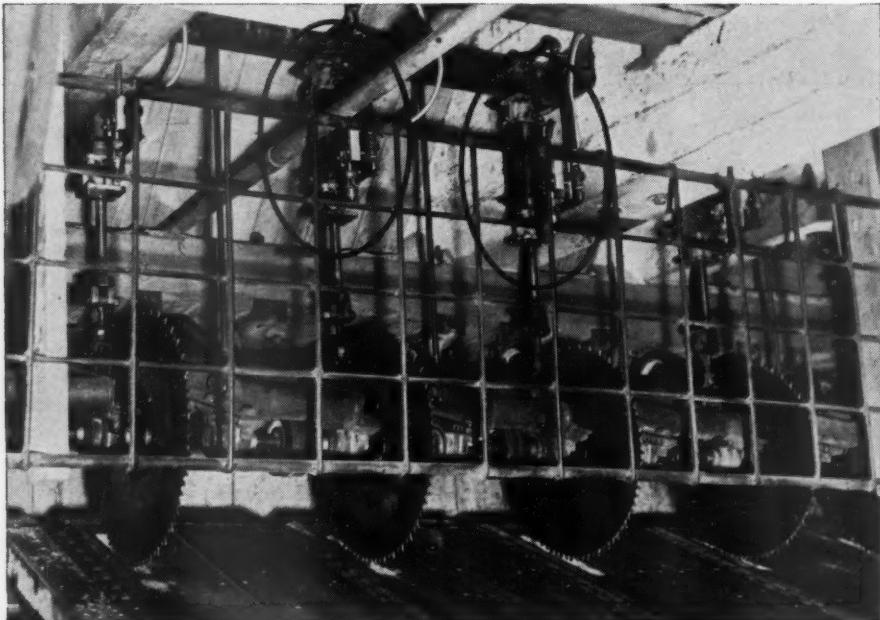
ONE of the newer of the many applications of compressed air in sawmills is that in connection with a "pony" trimmer built by Galbraith & Sulley, Ltd., for a Vancouver, B. C., plant. It is a small version of the heavy automatic type that is standard equipment in most West Coast lumber mills. But where the latter takes boards and timber up to 8

inches thick and 40 feet long and trims and cuts them into commercial lengths, the maximum capacity of the smaller unit is around 4 inches and 21 feet, respectively.

The installation in question has eleven circular saws arranged side by side with varying distances between them: Nos. 1 and 2 are 1 foot apart; Nos. 2 and 3, four

feet; and Nos. 3 and 11, inclusive, 2 feet. Each is independently mounted above an inclined table in a hinged frame and is V-belt driven from a shaft passing through the hinges and direct-connected to a 40-hp. motor. The pneumatic feature of the trimmer is a group of 4-inch-diameter cushioned air cylinders, one to raise and lower each saw. They are of the heavy-duty Ledeen type and have a 6-inch stroke. Normally they hold the saws approximately 10 inches above the table. Drawing air at a pressure of 80 to 90 psi. from an overhead pipe, they are actuated independently or in any desired combination by Valvair 3-way solenoid valves remote controlled from a push-button panel at the operator's station.

Motor-driven chains on 2-foot centers with lugs every 3 feet carry the lumber over the inclined table to the trimmer at the rate of one every $1\frac{1}{2}$ seconds, two saws meanwhile cutting off the ends and producing boards of even or odd lengths in 1-foot multiples, depending upon their position on the traveling chains. They are generally placed so that Saw No. 2 trims the end nearest the operator, thus providing pieces 4 to 20 feet long. But to prevent wastage, Saw No. 1 sometimes does the work. In that case the boards may be anywhere from 5 to 21 feet long. In addition to trimming, the saws may be used for other purposes. Any two or more may be dropped to cut out bad spots or, spaced 4 feet apart, to chop slabs or entirely defective boards into cordwood.



IN CUTTING POSITION

Shown here are a few of the eleven circular saws on the "pony" trimmer. Each is connected to a vertical air cylinder (in black ovals) by which it can be raised and lowered at the rate of 40 times a minute.

Determining Leakage Losses in Compressed-Air Systems

Lewis H. Carter

HOW much air are we losing because of leakage? What does it cost? These questions often bother the factory maintenance supervisor who is responsible for supplying compressed air through a network of lines to many "users." Careful as he may be in eliminating audible leaks, unless he has a method of accurately testing the system, he is never sure that he has detected them all.

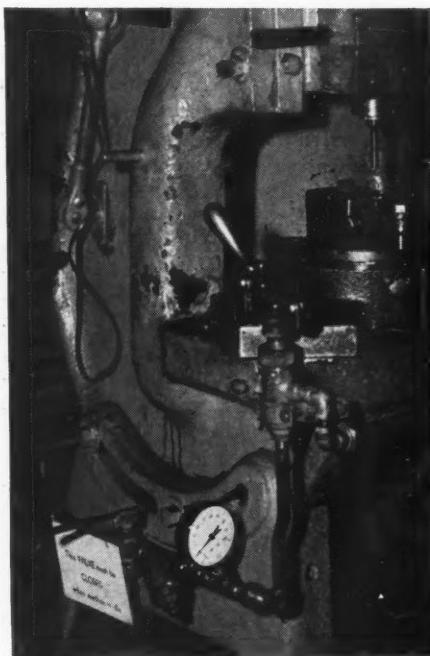
By a simple method followed by the Worcester Pressed Steel Company it was possible to determine not only the amount of air lost at the points of application and in the piping system between the compressor and the machines but also its cost. The firm then knew how much it could afford to spend to eliminate the losses. The tests also revealed which of the users were the worst offenders and required immediate attention.

Before any check was made, each machine was equipped with a stop cock which, when closed, cut off the supply of air ahead of all outlets and control valves. Although each already had a shutoff, it could not be relied upon and was replaced in every case by a 125-pound steam cock. On the user's side of the latter was installed a strainer and a tee for the insertion of a test gauge when de-

sired. The tests were conducted during the lunch period, when no air was consumed, and on two consecutive days. One was made with all stop cocks closed and the other with all stop cocks open.

The air was furnished by a 304-cfm. Ingersoll-Rand Type ES-1 compressor with a discharge pressure of 85 psi. For the purpose of the tests it was clocked by a stop watch, graduated in decimals of an hour, which was started from zero each time the unloading valve opened or closed. This gave the elapsed time it was idling and the elapsed time it was loaded, the sum of the two being the cycle time. The recorded time was the average of all the readings made during each test. Wattmeter readings were taken to ascertain the horsepower needed by the compressor when idling or when loaded. The cost of electric current per meter horsepower per year was set at \$500.00.

To determine the leakage at each machine, a test gauge was inserted in the tee which was provided for that purpose. After closing the cock, the pressure drop within 30 seconds was noted. These readings were compared and showed which equipment needed immediate attention. In nearly every case the control valve was found to be defective. Since this resulted in a monetary loss of more



TEST EQUIPMENT

The air-supply line of a press fitted with a special stop cock followed by a pressure gauge.

than \$500 a year, the economies effected by repairing or replacing the valves would cover their cost in a short time.

The tests involved 146 users and, roughly, 1000 feet of piping between them and the compressor. At the time they were undertaken there were no audible leaks anywhere in the system, showing that it is possible to have a multitude that are not ordinarily detectable and that can run into an appreciable loss in dollars and cents.

The accuracy of the tests depended upon a perfectly airtight shutoff at each machine. Because the cost of a reliable cock, plus that of installation, is fairly high, it was necessary to decide whether or not the savings justified the outlay. The facts which governed the matter were these: Roughly, 90 percent of the users were presses, and each had two manually operated valves which controlled the action of the clutch. Many had rubber-hose take-offs to auxiliary apparatus. This added up to some 350 possible leakage points. Eliminating the leaks at all of them would take a considerable length of time, and it was preferable to spread the cost of material and labor over a period of months.

With the cocks as installed, it is possible to locate the worst offenders by means of the gauge test and to make immediate savings by requiring operators to keep the cocks closed on idle equipment. Instead of providing one plug cock for each user, a compromise can be made

TEST NO. 1, ALL STOP COCKS CLOSED

Loaded time.....	0.0063 hr.
Idling time.....	0.0654 hr.
Cycle time.....	0.0717 hr.
Ratio loaded time to cycle time.....	0.0880
Ratio idling time to cycle time.....	0.9120
Cycle time.....	1.0000
Electrical horsepower used	
Compressor loaded.....	70 hp. x 0.088 = 6.26 hp.
Compressor idling.....	15 hp. x 0.912 = 13.65 hp.
Average horsepower.....	19.91

If all leaks had been eliminated, the compressor would have been idling 100 percent of the time and would have used 15 hp. The excess over and above 15 hp. was needed to compensate for leaks between the compressor and the stop cocks. It amounted to 4.91 hp. and involved an expenditure of \$245.50 a year.

TEST NO. 2, ALL STOP COCKS OPEN

Loaded time.....	0.0089 hr.
Idling time.....	0.0189 hr.
Cycle time.....	0.0278 hr.
Ratio loaded time to cycle time.....	0.3300
Ratio idling time to cycle time.....	0.6700
Cycle time.....	1.0000
Electrical horsepower used	
Compressor loaded.....	70 hp. x 0.330 = 23.10 hp.
Compressor idling.....	15 hp. x 0.670 = 7.08 hp.
Average horsepower.....	30.18

In this case the excess power required to make up for leakage in the whole system totaled 15.18 hp. and cost \$759 per year.

ANNUAL COST OF LEAKAGE

Total amount, whole system.....	\$759.00
Pipe lines.....	245.50
In equipment at user.....	\$513.50

by grouping several machines and controlling them by a single shutoff. If it is desired to ascertain the cost of the compressed air for the purpose of allocating it to the respective users, and if no flow meter for measuring the amount generated is available, fairly accurate results may be obtained by the tests outlined.

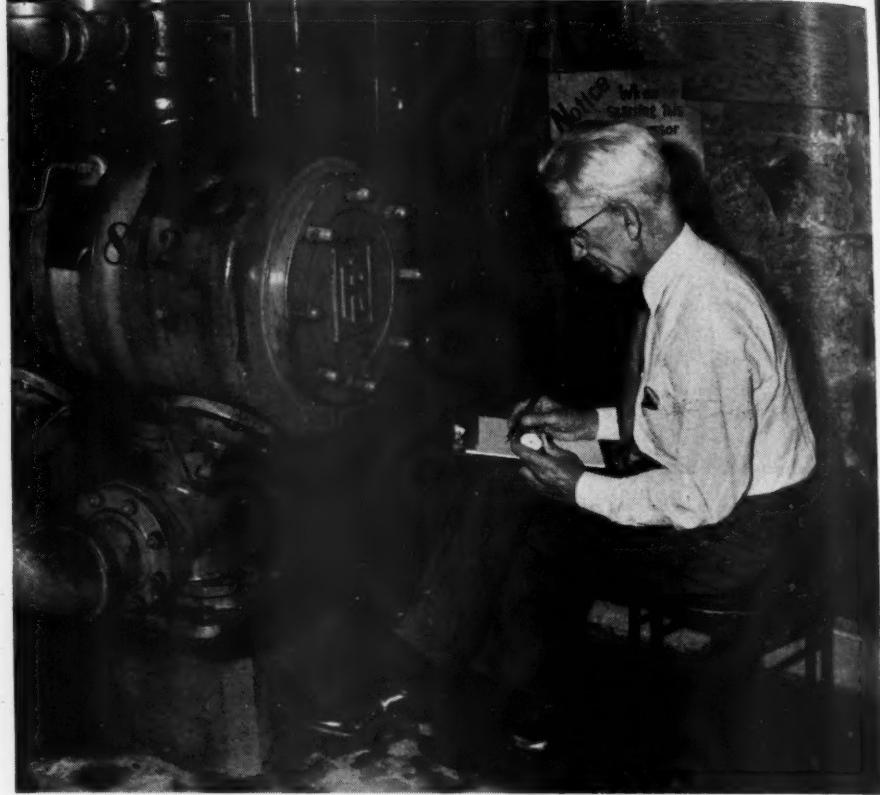
To arrive at an average more nearly representative of working conditions, it is necessary to know the ratio of loaded time to idle time over a longer period than that on which the tests were based. By rigging up a device for closing an electrical circuit during the interval the compressor is loaded, and by putting an electric clock in the circuit, the loaded time will be integrated. Comparing this integrated loaded time with the total time the compressor is in operation will give ratios as worked out in the tests. Assuming that this time was found to be thirteen hours in a 40-hour week, the total volume of air produced in a year by a compressor of the type used would be: $304 \text{ cfm.} \times 60 \times 13 \times 52 = 12,330,240$ cubic feet. At \$50 per horsepower per year, the cost for electric current (70 hp. $\times 13/40 + 15 \text{ hp.} \times 27/40$) would be \$1,644.75. To this should be added the outlay for cooling water and the proportional cost of the fixed expenses of the station.

Marking Michigan Highways

Painting traffic guide lines on the nation's highways is a big job. In Michigan, for instance, it costs \$250,000 a year, and it takes from three to four months to remark some 7500 miles of hard-surfaced trunkline roads. This year, seven crews, with as many striping machines, started the task in the southern counties in May and are steadily working their way northward.

Because the average driver will not refrain for more than a limited time from crossing and smearing freshly painted lines, much study goes into developing quick-drying paints and applying them under varying weather conditions and at different times of day to determine the effects. Michigan highway engineers specify a paint that will dry to the smear-proof stage within ten to twenty minutes. At the usual striping speed, this means that there are about 2 miles of wet paint behind a machine, and "no-crossing" flags are stationed that entire distance.

Michigan's 1950 program will require 79,500 gallons of paint. Of this, 24,750 gallons will be yellow for marking center lines of 4-lane undivided highways and no-crossing lines on hills and curves of 2- and 3-lane stretches. Another 39,750 gallons will be white to mark blacktop roads and some concrete surfaces. Finally, 15,000 gallons of black



TIMING OPERATION OF COMPRESSOR

The author is shown taking stop-watch readings at the compressor to determine operating and idling time during each cycle.

This and That

paint will be applied to certain concrete highways where that color seems to be the most effective. All yellow and white paint is rendered luminous at night by adding millions of tiny glass reflectorizing beads. About 6 pounds are used for each gallon of paint.

Unusual Cooling Application

Disposal of slag from blast furnaces located in urban areas presents some problems because there is little room where it can accumulate. These conditions prevail at the Pittsburgh Works of Jones & Laughlin Steel Corporation. There the molten material remains in pits only long enough for it to solidify and is then removed by the Duquesne Slag Products Company and processed for use in building blocks, as a road-surfacing material, etc. Loading into cars is done with a power shovel, and the operator's lot was formerly an undesirable one. The temperature of the air mounted as high as 160°F., and fumes, dust, and steam rose from the slag. Two large propeller-type fans were mounted on the front of the shovel in an effort to improve conditions, but their effectiveness depended largely upon the direction and velocity of the wind.

Now the operator works in relative

comfort, thanks to equipment that cools the cab. Mounted on the top of it is a Dravo air-conditioning unit of the ammonia compression type. It delivers 400 cfm. of air to the cab and also cools and ventilates the machinery compartment of the electric shovel. Three-quarters of the cab air is recirculated. The remainder, which is taken from the outside, is filtered and passed through canisters containing activated carbon to remove fumes and gases.

New Metal Facts

Although textbooks have always stated that metals melt and solidify at identical temperatures, it isn't true according to metallurgists of the General Electric Research Laboratory. Examination under special microscopes of droplets of molten metals that are entirely free of impurities reveals that they solidify at much lower temperatures than they melt. When impurities are added, the melting and solidification points coincide, as the textbooks state. Selenium, bismuth, lead, antimony, cobalt, iron, and palladium have so far been studied, and in all cases the temperatures at which the pure droplets solidified were roughly 20 percent below the melting points of the metals in terms of degrees above absolute zero.

EDITORIALS



SILTING OF RESERVOIRS

THE often expressed fears that reservoirs on some of our western rivers will become filled with silt in a comparatively short time have been determined to be groundless by the Bureau of Reclamation. The latter has contended right along that this was so, but up to now has had little more than theoretical calculations to back up its stand. During the past two years, however, the U. S. Geological Survey and the Navy Department have measured the actual rate of siltation in several reservoirs, including Lake Mead, which was created by Hoover Dam and is the world's largest man-made body of water.

Reporting on these investigations, Oscar L. Chapman, Secretary of the Interior, states that it will require at least 275 years for Lake Mead to become completely filled with material borne by the Colorado River even if no upstream dams are built meanwhile. Actually, several of the latter are in the drawing-board stage. Studies reveal that Lake Mead has trapped an average of 105,500 acre-feet of silt each year since water storage began in 1935. This is just 500 acre-feet more than was predicted by Bureau engineers before Hoover Dam was reared.

At this rate, the basin will not be entirely filled with silt until the year 2225. Actually, the engineers say, the silt will not build up at the prevailing rate because lower deposits will be greatly consolidated as additional tons of material are superimposed upon them. Taking this into account, they compute that the reservoir will have some useful storage space until the year 2380.

Methods developed by the Navy to locate submarines and sunken ships and to chart the ocean floor have been used in the reservoir investigations. They show that coarse gravel and sand settle soon after they reach the backwater of the lake, while the more finely divided material is carried farther into the body of the reservoir. The old river channel of the Colorado is now filled, but there has been little sedimentation outside its

boundaries except at the head of the lake. The storage capacity of the reservoir is computed at 29,827,000 acre-feet, as compared with its initial capacity of 31,142,000 acre-feet.

Similar investigations in the reservoir behind Elephant Butte Dam on the Rio Grande River, which is known as a bad silting stream, disclose that it has lost 16½ percent of its capacity in 32 years, indicating that it still has 160 years of service ahead of it. The Arrowrock Reservoir on the Boise River in Idaho has lost only 2.76 percent of its capacity in 32 years, and at that rate of siltation is good for 1100 more years.

The Guernsey Reservoir on the North Platte River in Wyoming has the highest rate of siltation of any U. S. Reclamation storage facility so far studied. In twenty years 33 percent of its capacity has been taken over by silt. But even at this rate its useful life will extend well beyond the 40-year payout period.

Commenting on the results of the investigations, Secretary Chapman said: "Some misinformed people say it is wasteful to build big dams such as Hoover because they will soon be ruined by silt. That is just simply not true." He urged, however, that vigorous conservation measures be taken to prevent excessive erosion and to keep the silt on the land where it belongs.

TRAINING EXECUTIVES

IN THIS age of specialists, men who know how to do one thing well constitute a major part of our working force. The day of the jack-of-all-trades has passed. The American system of manufacturing is based on dividing big operations into a multitude of little ones. Each worker thus learns his particular job thoroughly. Then, if everyone does his allotted part, the production machine clicks. That is, it does if it is properly directed. Without competent management to gear each operation smoothly with the others, chaos can result. Even a baseball team composed of experts at every post will not win consistently un-

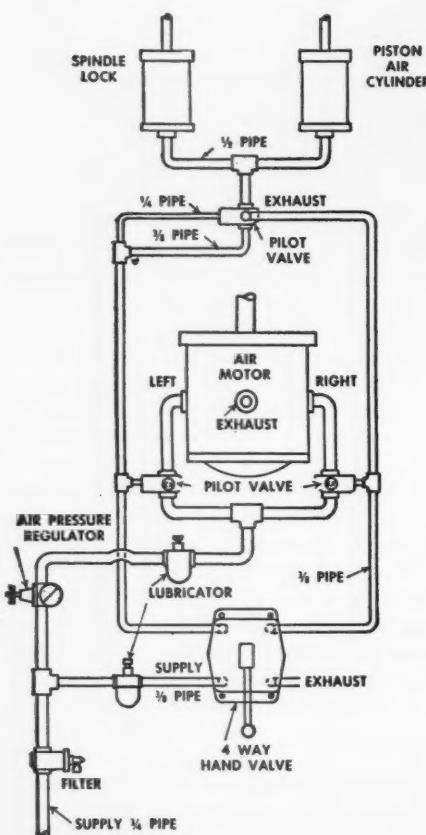
less someone does its master-minding.

In the industrial world, this emphasis on specialization is creating a dearth of executives, according to Ralph J. Cordiner, executive vice-president of General Electric Company. Too few men get a chance to learn how all the positions should be played, and without that knowledge they can't lead the team to victory. Industrial executives who have been at the helm for many years are compared by Mr. Cordiner to a family doctor. The present-day manager knows his business, he states, because he has been with it "through its labor pains, its growing pains, and, in place of measles and mumps, two world wars and a depression. His successor, however, must come from the ranks of specialists whose specialties have narrowed their outlook and who have not had natural opportunities to exercise leadership.

"Companies have for a long time done a good job of recruiting and early training, but too often, at the most critical period in the development of an executive, we have neglected to provide any opportunity for training at all. We suddenly find ourselves doing one of two things: We take the man who has been specializing during some of the most important formative years of his life and give him a title, saying, 'Now, you're a manager.' Or we find ourselves saying, 'We'd like to promote a man from within the ranks, but none of them has the proper qualifications.' "

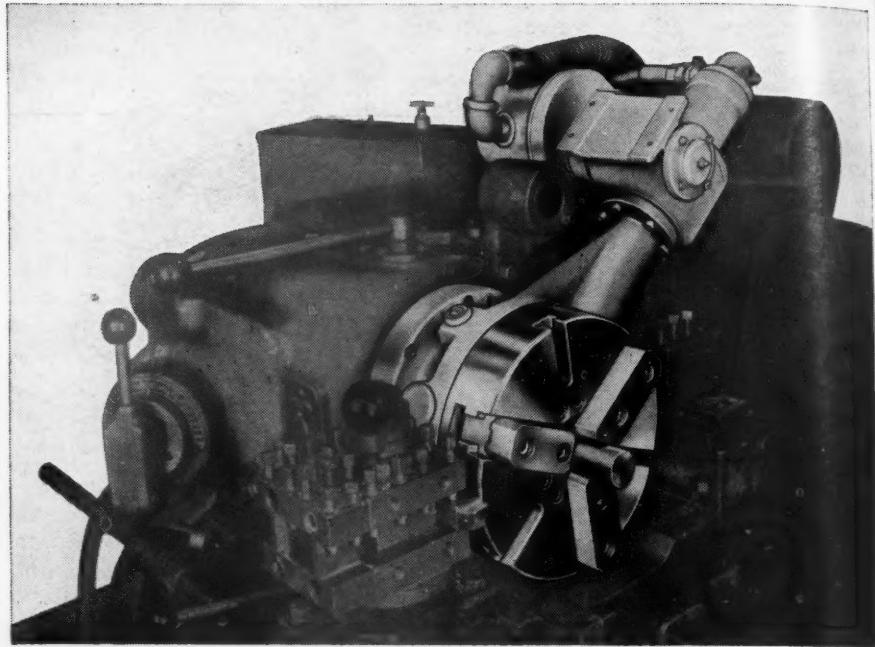
Mr. Cordiner suggests two courses as a remedy for the situation. First, he would rotate selected specialists on jobs of different kinds to give them a well-rounded-training. Second, he would provide all executives with understudies or assistants who would concern themselves with the over-all managerial aspects of an organization's operations. These men should, he states, have a chance to learn how to select people and coördinate their efforts by defining responsibility, authority, and accountability. Also, they should come to understand human relations, and develop sensitivity for social, economic, and political trends.

Heavy-Duty Chuck Powered by an Air Motor



A NEW type of automatic chuck called Air-O-Torque has been developed by The Whiton Machine Company and is said to combine the best features of a pneumatic chuck and a chuck operated by a power wrench. It is made up of two components: a heavy-duty gear scroll chuck and a power unit. The latter consists of an air motor, worm gear, worm shaft, and a retractable splined pinion shaft and is built into the chuck housing, which is attached directly to the machine headstock.

Control of the chuck is effected by a 4-way, hand-operated valve. Power produced by the air motor is transmitted through the worm gearing and shafts to the scroll, causing the jaws to open or close. Air pressure used to operate the motor can be varied from 0 to 90 psi. by a regulator, thus altering the amount of torque developed by the unit and insuring a positive grip on the work. The jaws can be moved a fraction of an



INSTALLATION VIEW

The chuck mounted in working position with the air motor mounted towards the rear of the machine. This arrangement leaves a clear center hole for the insertion of the work, which ranges from bar stock to round and irregular pieces. The drawing shows the layout of the control system.

inch or any distance within their limits.

The center-hole chuck can take bar stock, round or irregularly shaped work, thin-walled pieces, etc., with equal facility, and as the scroll can be engaged at any time anywhere on the chuck periphery by the retractable pinion shaft it is not necessary to locate the pinion opening manually when inserting work.

The body of the chuck is an alloy-steel forging, and a special heat-treated

alloy steel is used for the heavy-duty jaws and the scroll, which is chrome-plated for long wear and accuracy of operation. The Air-O-Torque is suitable for use with lathes, boring mills, automatic chucking machines, etc., and can be fitted to any American Standard spindle or designed for a special spindle or plate. It comes in seven sizes from 8 to 24 inches chuck diameter. Larger units are obtainable.

Leak Detector for Pneumatic Control Systems

BRITAIN is known to prefer pneumatic to hydraulic control systems for aircraft, and that explains the development there of a device for the detection and location of leaks in compressed-air lines on planes. The instrument consists of a control unit and a hand-held detector with a long nozzle to probe the atmosphere for the presence of a "tracer gas"—a halogen compound that is injected into the air system in liquid form. It is nontoxic, and is easily introduced from small cylinders containing 1 to 2 ounces, giving a concentration at full testing pressure of about 1 percent.

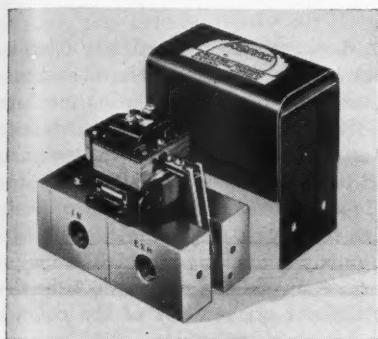
The detector has a motor-driven impeller, an element sensitive to vapors of halogen compounds, and a small loudspeaker which normally emits a clicking sound. When in use, the impeller draws ambient air through the element, and when the latter detects in it the presence of the tracer gas the frequency of the clicking sound is amplified, giving an audible signal. The meter reading on the control unit increases at the same time, visually indicating a leak in the com-

pressed-air line at the test point. It is claimed that air with a halogen-vapor concentration of 1 percent or less escaping from a line at the rate of $\frac{1}{2}$ cubic centimeter per minute is readily detected. In terms of a pneumatic system having a total capacity of 300-400 cubic inches and operating at 1000 psi., this corresponds to a fall in air pressure of 2 psi. in 24 hours.

The required amount of tracer gas is injected into the pneumatic system when it is under reduced pressure so that it will be carried into the main receivers when the lines are under full pressure. In service, it is the practice first to test main zones such as cockpits, nacelles, etc., for possible leaks and, if found, to seal them before searching for lesser ones in the same area by placing the nozzle right against the pipe-line joints. Where these are somewhat inaccessible, a telescopic probe can be used. And in zones where background noises are excessive, the operator wears headphones so that he will be sure to hear the clicking sound that indicates a leak.

Industrial Notes

Model SL is the designation of a new Nopak ring-type solenoid valve announced by Galland-Henning Manufacturing Company. The unit is small and lightweight and has a 3-piece body machined from drawn aluminum that can be easily dismantled. It is energized by a continuous-duty, standard solenoid

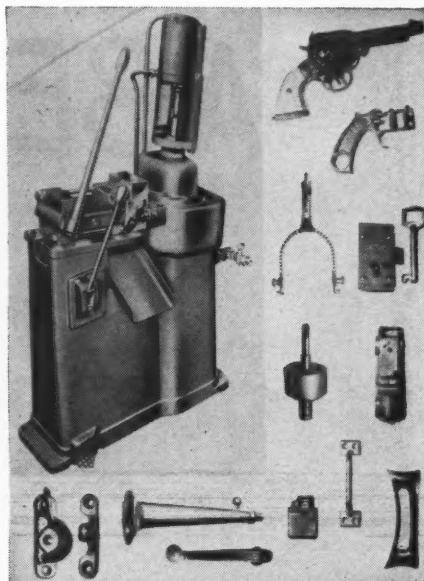


that actuates a pilot and that is said to function efficiently even when submerged in oil. Neoprene "O" rings are used for sealing. At 220 volts, with a consumption of 0.96 ampere, it develops a pull of approximately 3 pounds and is operated with air at 40 to 250 psi. At present it is available only in the $\frac{1}{2}$ -inch pipe size which can be bushed down to $\frac{3}{8}$ - or $\frac{1}{4}$ -inch size. The SL is designed for long-

run, high-speed service or for continuous energization in one position.

In addition to supplying wrapping paper that is intended to protect products against corrosion, Nox-Rust Chemical Corporation is now equipped to make cartons of a similarly treated material to order. The chemical with which it is impregnated vaporizes and is said to offset the harmful effects of moisture that may be trapped in a package when it is sealed.

Die Casting Machine Corporation has announced a zinc-alloy die caster of 1-pound capacity that is said to combine fast chill and high cycling speed. Using single-impression dies up to 6x9 inches in size, direct valving "explodes" air under pressure into a charging cylinder, causing the piston to shoot hot molten metal into the die cavities before it has a chance to cool off and resulting in a small water-cooled sprue that solidifies instantly. Fabricated die blanks into which cavities can be machined are supplied with the machine. According to the manufacturer, the new model can maintain an average output of 500-700 shots an hour and eliminates most secondary operations and finishing costs. It oc-



cupies only 24x12 inches of floor space, making it especially suitable for small-parts producers who depend upon outside sources for their castings.

Pipe joints made with a new compound put up in cans by Hercules Chemical Company are claimed to be not only leakproof but easily broken. Product can be applied directly from container without mixing and is especially suitable for screw joints on water, steam, gas, compressed air, and ammonia lines, as well as for pipes carrying dilute acids and alkalies. Can be used without lampwick on brass piping.

Stone-Dri is the trade name of a waterproof enamel for the protection of masonry such as cement, stucco, and concrete. A product of Sapolin Paints, Inc., it is compounded to withstand the destructive chemical action of the lime and alkali in those materials, as well as to resist heavy traffic. It is said to retain the elasticity and toughness of its plastic-rubber base, which causes it to flow freely even on rough surfaces. The enamel is available in silver, lead gray, red, and green.

Metals exposed to temperatures ranging from 500 to 1200°F. are made heat resistant, it is claimed, by an aluminum paint called Tecosteel offered by Thompson & Company. It is applied by dipping, brushing, or spraying and air dries in twelve to eighteen hours. Can be baked dry at 350° in fifteen minutes. Recommended for coating annealing boxes, furnaces, hot air ducts, smokestacks, and superheated steam lines.

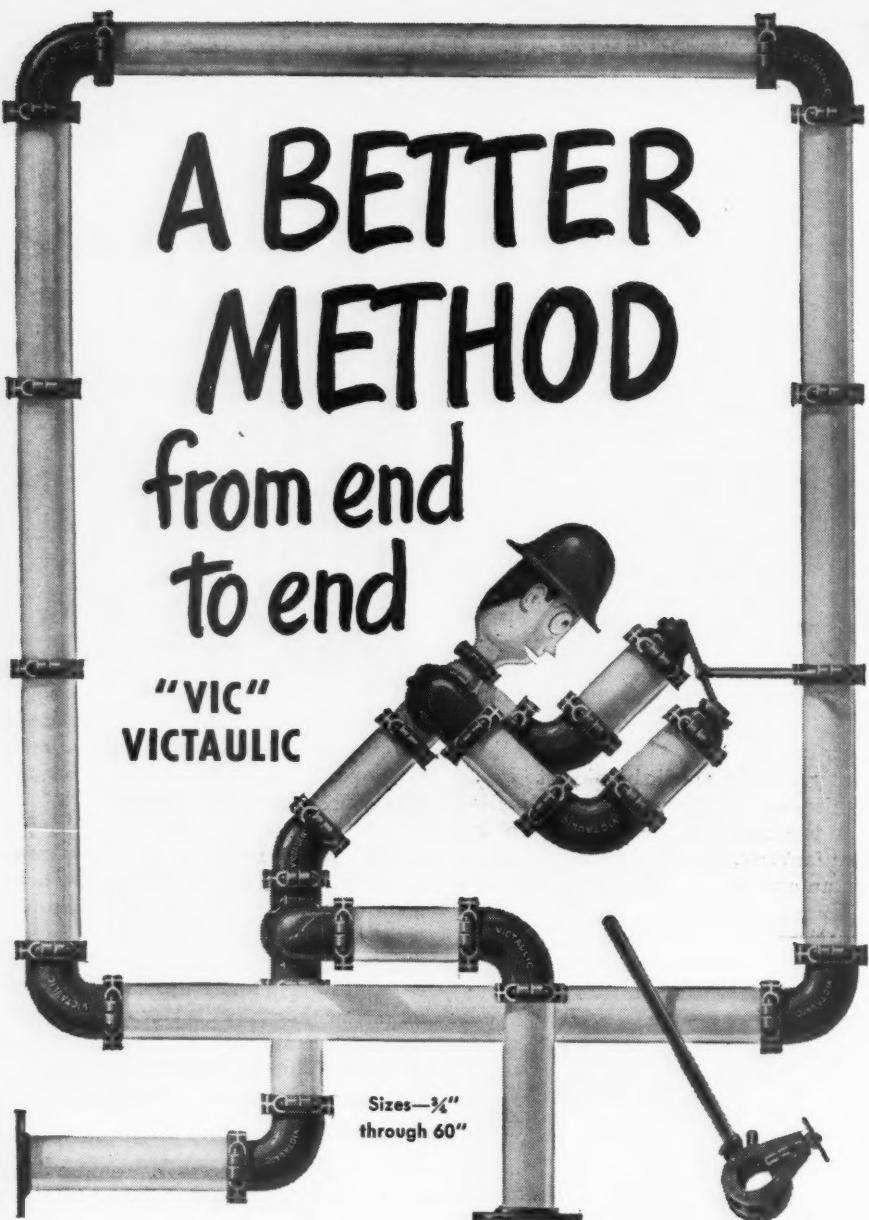
Reinforced tubing that is said to be highly resistant to rupture and collapse is offered in a wide range of diameters by



INTERNATIONAL NEWS PHOTO

NATION'S LONGEST VEHICULAR TUNNEL OPENED

Aerial view showing the route of the 9117-foot-long Brooklyn-Battery twin bores that link New York's Manhattan (in background) and Brooklyn boroughs. It was dedicated and opened to traffic on May 25 after being under construction intermittently since 1940. Each of the two tubes can handle 2800 vehicles an hour, with an average driving time from end to end of 3½ minutes. Tolls to repay the Triborough Bridge and Tunnel Authority for the \$80,000,000 expended range from 35 cents for cars to \$1.25 for trucks. A description of the construction of the tunnel was published in our September and October, 1947, issues.



No matter how you look at it, VICTAULIC offers a method of piping that will save time, work, and dollars on construction and maintenance from one end of the line to the other.

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Victaulic Company of Canada, Ltd., 200 Bay Street, Toronto 1
For Export outside U.S. & Canada: PIPECO Couplings & Fittings;
Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N.Y.

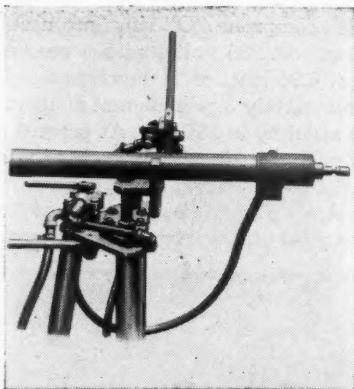
26TH VICTAULIC YEAR

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Flexible Tubing Company. Standard construction has a rustproof spring-steel helical core covered inside and out with cotton duck coated with Neoprene. Special types with multiple-ply walls and varied coatings are made to meet different service needs. According to the manufacturer, tubing is easily assembled and retractable. Named Spiratube, it is suitable for conveying gases under high pressure or vacuum, as well as light solids in powder or granular form.

A device that automatically feeds bar stock to turret lathes and hand and automatic screw machines is being marketed by OK Specialty Company, Inc. Mounted on tripod standards, it has a pneumatic feed tube that positions and aligns stock and feeds any desired length into the machine-tool spindle. A feature of the equipment is a plunger which stops just short of the collet jaws so that the final stub is not pushed out of the collet to damage tools, and waste due to long ends is eliminated. The plunger is withdrawn

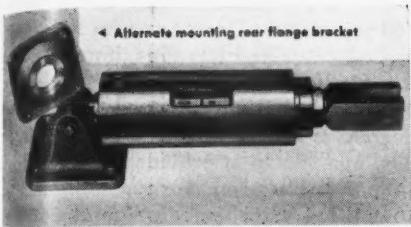


by actuating an air-control valve, and a special safety device shuts off the air supply when the feed tube is in the re-loading position. The device is operated with low-pressure air and will handle steel, brass, and aluminum rods, thin-walled tubing, and plastic stock in lengths up to 12 feet, in diameters limited only by the capacity of the spindle, and in round, square, hexagonal, rectangular, and other shapes. According to the company, the device, which feeds without surface contact, does not scratch or mar material, thus permitting the use of polished stock.

At the recent Philadelphia, Pa., tool show, Modernair Corporation exhibited what it describes as the first double-acting Air Return pneumatic cylinder. After the initial charge, it uses the same volume of air that a spring-return cylinder consumes, or half the amount required by a conventional double-acting cylinder. It may be operated by a 3-way valve and still permit throttling to provide for control of the work and of the return stroke. According to the Company, there is no residual pressure on the forward stroke, and the return stroke is

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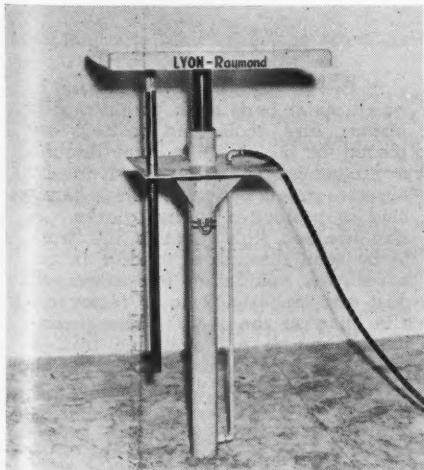
made at 60 percent efficiency by use of the 3-way valve. Built of brass, stainless steel, and aluminum, the Air Return is light in weight, and elimination of the spring-return element permits a reduction in over-all dimensions. The only replacement necessary is O-ring packing because there are no moving parts to wear, no metal to metal contact. The cylinder will soon be available in 1 1/8-, 1 3/4-, and 2 1/2-inch bore sizes.

Concrete blocks with an integral brick facing is a new building material introduced by National Bric-Block, Inc. It is made in all standard sizes in any color or combination of colors and with a plain or rough surface.

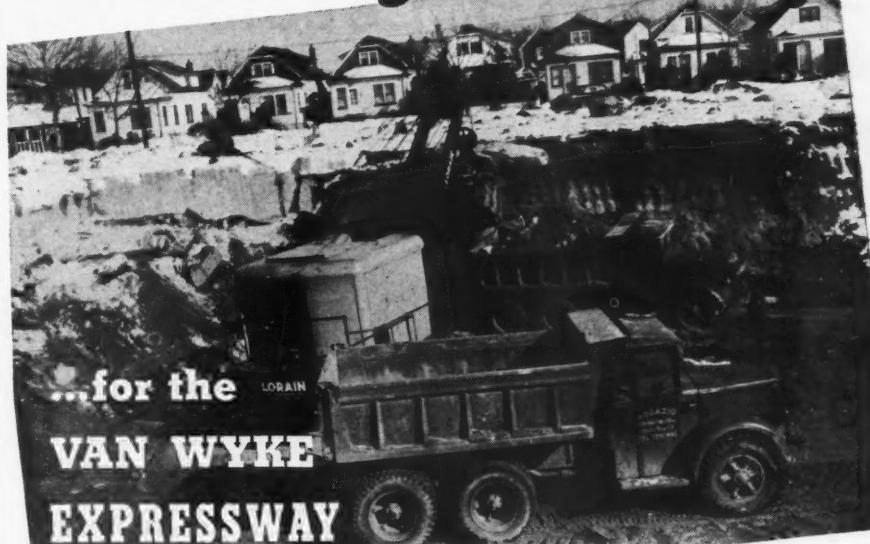
A 2-inch drain cock designed by Master Equipment Corporation for compressed-air systems is said to eject water and oil twice each time units taking air from the lines function. The device weighs only 3 1/2 ounces and operates on the principle of pressure build-up and relief. It can also be adapted for use with automotive air-brake systems.

For field or shop use there is now available in a grained-cowhide case a pocket microscope that is said to be the equal of laboratory instruments in quality. It is free from prismatic aberrations and has an adjustable magnification range from 20 to 60 power. Made by Clarkston Corporation, it is designated as Model 233.

Engineers of the Lyon-Raymond Corporation have designed a simple form of elevating platform for light loads that is supplied as a packaged unit ready for installation below floor level. It is of the



Clearing the way



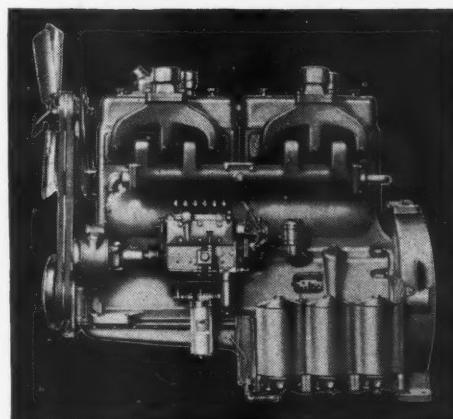
● Earth must move—before traffic can. So they're digging with Diesels—Waukesha Super-Duty Diesels! And at the rate the shovel is digging against this 16 1/2-ft. embankment, that new New York State highway—the Van Wyke Expressway—will be completed in 1950 right on schedule.

The place is Long Island. The E. J. Varrone Construction Co., South Ozone Park, Long Island, N. Y., own the shovel. It's a 2-yd. 820 Lorain shovel—powered by the Waukesha Super-Duty Diesel Six.

It's a potent power producer—this heavy-duty, four-stroke cycle, overhead valve Diesel engine. With the exclusive patented combustion chamber used in all Waukesha Diesels you get unusual Diesel performance . . . clean burning with all standard "high speed Diesel fuels" . . . lively acceleration . . . high economy . . . easy starting . . . simpler maintenance. Send for Bulletin 1415.

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Diesel ENGINES

**WAUKESHA Super-Duty Diesel
(Model 6-WAKD)**—six cylinder, 6 1/4-in.
bore x 6 1/2-in. stroke, 1197 cu. in. disp.

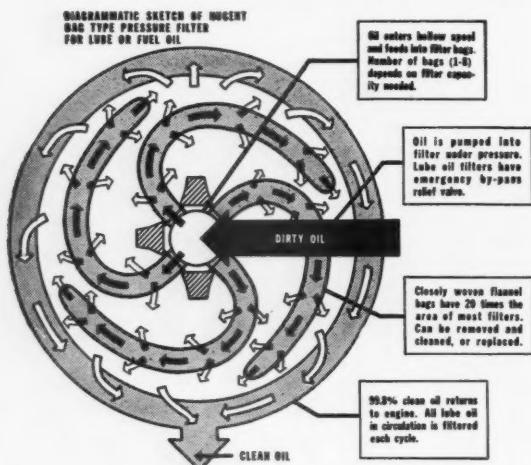
19 Years of Protection for 7 Diesel Locomotives



with NUGENT "Full Flow Filtering" Pressure Filters

In 1930 Bush Terminal Warehouse, Brooklyn, N. Y., put into service seven Ingersoll-Rand diesel powered G. E. locomotives. All were equipped with Nugent "Full Flow Filtering" Bag-Type Filters for lube oil. Now after 19 years all seven locomotives are still in service and only one has had to be overhauled (that after 18 years service). The Nugent Filters are cleaned every three or four months and the bags washed and re-used. Here is proof of the long term economy and effectiveness of Nugent Full Flow Filtering.

Nugent "Full Flow Filtering" Filters are equally effective on compressors, pumps, turbines, gas engines, machinery etc. and may be used on a wide variety of oils and other fluids. What is your problem?



What is "Full Flow Filtering"?

"Full flow filtering is complete filtering of all the oil every cycle. No unfiltered oil bypasses the filter carrying harmful foreign material to moving parts. In Nugent "Full Flow Filtering" Filters, dirt is collected on the inside of the filter bags which when clogged can be cleaned and reused or discarded and replaced at your preference. For Maximum economy and longest equipment life be sure and specify Nugent "Full Flow Filtering" Filters."



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piston type operated with air at 90 to 100 psi. pressure by a hand- or foot-controlled valve and has a maximum capacity of 300 pounds. The top measures 30x30 inches and is designed to turn 360 degrees or lock in various fixed positions. The one shown is provided with a stop to prevent it from turning and has a total lift of 36 inches from a point 6 inches above the floor.

Another hardening compound for tool steel has been made available, this time by Doughty Laboratories, Inc. According to the company, the material is rich in chromium which, when fused with the metal, adds ingredients that have both an alloying and a nitriding effect. The result is a hard surface that is exceptionally impregnable and resistant to wear, corrosion, and high temperatures, while the core remains tough and flexible. The process is said to increase the life of a tool-steel drill, for example, as much as 300 percent.

Q 200 is the designation of a new fluid put on the market by Barco Chemical Products Company for degreasing metals and alloys preparatory to painting, lacquering, anodizing, metallizing, and electroplating. It is applied cold, thus preventing distortion through expansion and contraction when parts are cleaned with hot solutions or vapors. The chemi-



BENCH BLAST CABINET

Small metal parts such as automobile pistons, dies, tools, and castings are placed in this blast cabinet through a hinged cover and rotated in the abrasive stream by the operator's hands clad in protective rubber gloves. A side-mounted light permits the work to be seen through a window in the cover. A ventilating fan draws off dust and delivers it to a removable filter bag at the rear. Where compressed air is not available from a plant line it is furnished by a 5-hp., 2-stage compressor. The cabinet is made by The W. W. Sly Manufacturing Company and occupies a bench space of 14 x 18 inches.

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cal is said to remove all traces of wax, oil, grease, moisture, and grimy finger prints. It also dissolves pitch and resins by which lenses are held in place during grinding.

By law, enacted last February, Alcoholina—a mixture of alcohol and gasoline—is now the national fuel for motor vehicles in the Republic of Panama.

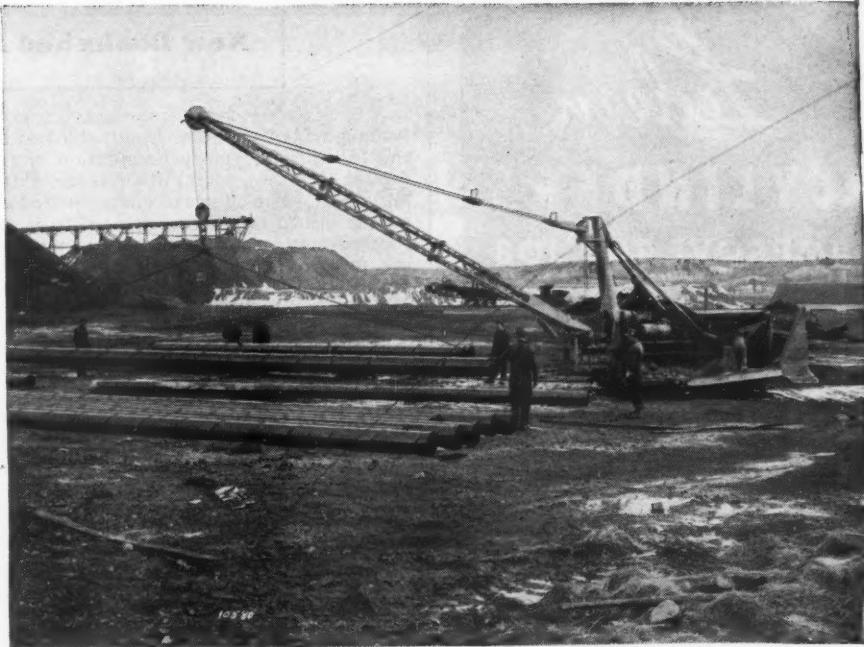
Putty in windows can be softened for removal by a portable electric tool that has a grip handle and can be plugged into any 110-volt outlet.

A new nozzle and a 4-finger trigger are features of a spray gun, Model GAT-2, recently announced by Eclipse Air Brush Company. The patented "47" nozzle makes it possible, it is claimed, to vary the spray pattern anywhere from the size of a silver dollar to a swath more than 12 inches wide, as well as to control it with accuracy. Adjustment is effected



by a thumbscrew on the gun and does not interfere with spraying. The trigger enables the operator to work for extended periods without finger fatigue and permits him to wear bulky gloves. The GAT-2 is served by separate lines for compressed air and coating material and can project a stream in a pattern up to 6 feet beyond the operator's reach. It is recommended for high-speed production painting in such fields as railroad, marine, building construction, and plant maintenance.

A new-model air purifier to which from one to six hoses can be attached has been announced by E.D. Bullard Company. Light enough to be classed as portable, it has a capacity of 10 to 35 cfm. of free air with a maximum working pressure of 100 psi. preset and controlled by a safety valve placed ahead of the manifold receiver. Combined chemical and mechanical filtering is provided by a replaceable cartridge. Standard $\frac{1}{4}$ -inch tap threads permit connecting hose fittings to operate spray guns and tools, as well as air lines of protective breathing hoods or helmets.



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to find out what pipe
best fills your needs in
mining service.

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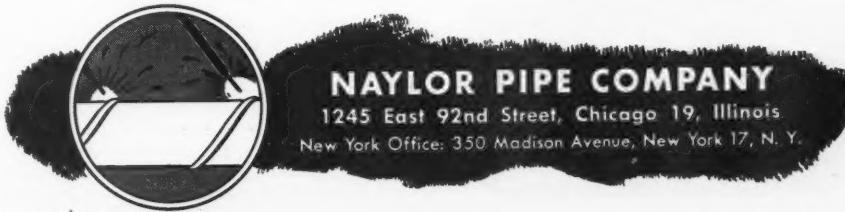
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New Books and Industrial Literature

A handbook of helps for industry in controlling air pollution has been published by the Industrial Hygiene Foundation of the Mellon Institute, 4400 Fifth Avenue, Pittsburgh, Pa. The effects of contaminated air on the health of persons exposed to it are fully covered, as are the chemical, engineering, meteorological, and legal aspects of the problem. Theories on how stack dust and smoke are dispersed in relation to stack and building heights and how gas velocity, temperature, and other factors influence air pollution have been reduced to engineering terms for the first time. The book also discusses the ventilation of valleys and how smog is formed. The price of the publication for nonmembers of the Foundation is \$2.00.

John Wiley & Sons, Inc., has published the twelfth edition of *Ken's Mechanical Engineers Handbook* in two volumes dealing with power and with design and production, respectively. The first, made up of twenty sections, covers the field of heat-power engineering and transportation, as well as the more important aspects of fluid flow. The rapid advances in mechanical engineering during the past decade and more made it necessary to scrap much obsolete material, but despite deletions the book is some 20 percent larger than the previous volume. Space formerly given over to steam engines, gas producers, etc., is devoted to more modern and less widely understood subjects such as atomic power, combustion gas turbines, supersonics, marine engineering, jet propulsion, heat pumps, panel heating, diesel and electric locomotives, axial-flow compressors, and instrumentation. The work on design and production is intended primarily for designers and manufacturers of machinery, appliances, mechanical equipment, and other engineered products. It has been almost completely rewritten and is more than 300 pages longer than the preceding edition. Its 28 sections are broadly classified under the headings: Selection of Materials, Design Principles, Design and Selection of Machine Components, Production Processes, Production Plant Equipment, and Mathematical Tables. In presenting each subject an attempt has been made to give the engineer a quick grasp of the essentials, together with pertinent technical data in condensed form such as basic principles, working formulas, charts, and tables; standard dimensions, proportions, and specifications; and illustrated discussions of typical equipment. Copies of the handbooks can be obtained from the publisher at 440 Fourth Avenue, New York 16, N. Y. Price, \$8.50 each.

Manufacturers of products that necessitate blind fastening or riveting can obtain a 20-page bulletin from The B. F. Goodrich Company, Akron, Ohio, on Rivnuts—one-piece blind rivets having threads for screw attachment that are widely used in metalworking and electrical industries. Booklet contains complete engineering and application data.

Basic reference data on compressed air and gas power has been compiled in booklet form by Compressed Air and Gas Institute. The three sections of the booklet cover uses of compressed air, theory of compressed air, and types of compressors. A copy can be obtained free of charge from the Committee on Engineering Education of the Institute at 1410 Terminal Tower, Cleveland 13, Ohio.

The resistance offered by nickel and its alloys to corrosion caused by caustic alkalies is the subject of a bulletin put out by

International Nickel Company, Inc. It reports on the behavior of these materials in a variety of fields such as soda manufacture, transportation, and the making of viscose rayon, soap, pulp, paper, and petroleum products and includes instructions on descaling and cleaning preparatory to welding the metals. A copy can be had by writing to the company at 67 Wall Street, New York 5, N. Y., and asking for Bulletin T-6.

A folder that deals with a pocket-size device for testing fluorescent lighting fixtures can be had by writing to Ideal Industries, Inc., 1440 Park Avenue, Sycamore, Ill. The instrument is designed to locate the trouble and to indicate whether it is in the circuit, starter, or lamp. Two models are available to service fixtures having tubes in the 15- to 40-watt or the 85- to 100-watt range.

W. H. Nicholson & Company, 12 Oregon Street, Wilkes-Barre, Pa., will send upon request a copy of its Catalogue No. 250 which deals with traps and separators for steam, air, or gas. In addition to capacity tables and installation diagrams, the publication contains data, charts, and formulae that enable users to determine the proper size of trap for each specific application.

Procedures which cranemen and hitchers should follow to work safely and effectively are set forth in a 36-page pocket manual prepared by Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Listing instructions they should follow, it also defines the extent of their authority and responsibilities. A copy is obtainable upon application to the company's health and safety department.

A bulletin on the proper handling and use of hydrogen-controlled welding electrodes can be obtained by writing to Arcos Corporation, 1500 South 50th Street, Philadelphia 43, Pa. Also available is literature dealing with three new additions to the firm's line of low-hydrogen electrodes which effect a time-saving in the welding of low alloy-high strength steels by the elimination of preheating.

A bulletin describing its new line of gear motors for speed reduction is obtainable from Abart Gear & Machine Company, 4828 West Sixteenth Street, Chicago 50, Ill. Standard speeds and ratios are as follows: Horsepower from 1/6 to 5; gear ratios from 5.4/5.1 to 100:1; and output speeds from 17.5 to 302 rpm. Motors are of the heavy-duty type. The bulletin gives sizes and ratings of single- and 3-phase models.

The sixth edition of a manual on steam hookups for steam traps, air vents, and industrial temperature controls can be had by writing to Sarco Company, Inc., Empire State Building, New York 1, N. Y. The publication is a handy source of information designed to help the user judge when and where steam traps or temperature controls are needed, what types and sizes to select, and how to install them properly.

Bulletin 2250 of Hagan Corporation describes a pneumatically operated instrument that measures differential pressures in the rate of flow of steam, gas, liquid fuel, water, and other fluids for indicating, recording, and control purposes. Its measuring range is from 100 inches water column to 25 psi. at static pressures up to 300 psig. It can also be used as a liquid flow meter. The bulletin will be sent upon request to the company at 323 Fourth Avenue, Pittsburgh, Pa.